SERVICE MANUAL

L26-FP-

AC-VTVM, Ballantine, 310A

HAMMOND ORGAN CO.

2915 N. Western Avenue -- Chicago 18: Illinois

MASTER FILE RECORDS

DO NOT SEPARATE CONTENTS

IMPORTANT

RETURN TO ELECTRICAL EQUIPMENT
SECTION FOR FILING WHEN NOT IN USE

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

AC-VTVM

DATE 5-19-71 TAG NO. L26-FP-1

EQUIPMENT NAME

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 7224

SUPPLIER " " P.O. #

DATE ORDERED 12-11-59 REC'D/COMPLETED 4-4-60 DELIVERED 4-10-60

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 235.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	4	Eng	Devel. Lab.	Musical Instr.		4-10-60
West	4	Eng	318-810	R. Bergslien		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)						
West.	4	Eng		Mathews		12-28-66 3-3-69

COMMENTS AND REVISIONS	DATE

FINAL DISPOSITION BY

IN – None TAG NO. L26-FP-1

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71 TAG NO. L26-FP-3

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 7383

SUPPLIER " " P.O. #

DATE ORDERED 2-8-60 REC'D/COMPLETED 5-16-60 DELIVERED 5-17-60

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT

PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	4	Eng	Devel. Lab.	Semiconductors		5-17-60
West	2	Eng	318-812	H. Thomiszer		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)

COMMENTS AND REVISIONS	DATE
W. King 4-19-67 3-18-68 D. Duffard 3-5-69	

FINAL DISPOSITION BY

IN – None TAG NO. L26-FP-3

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71 TAG NO. L26-FP-4

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 7706

SUPPLIER " " P.O. #

DATE ORDERED 8-5-60 REC'D/COMPLETED 8-29-60 DELIVERED

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	4	Eng	Devel. Lab.	EM&A		8-29-60
West	2	Eng	Elect. Des	Product Des	(transferred)	9- 8-69
West	2	Eng	318-812	H. Thomiszer		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)						

COMMENTS AND REVISIONS	DATE
W Lauba · 4-19-69 Trans 9-8-69	

FINAL DISPOSITION BY	

IN – None TAG NO. L26-FP-4

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71 TAG NO. L26-FP-5

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 7821

SUPPLIER " " P.O. #

DATE ORDERED 11-9-60 REC'D/COMPLETED 12-2-60 DELIVERED

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz- 2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	4	Eng	Design Lab	Product Des		12- 2-60
West	4	Eng	318-818	A. Petrie		1-71

LOCATION - IF NOT AS ASSIGNED (USE PENCIL ONLY)						
West	2			Lueckl		1-71

COMMENTS AND REVISIONS	DATE
E. Tomse 4-28-67 thru 3-3-69	

FINAL DISPOSITION BY

IN - None TAG NO. L26-FP-5

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71 TAG NO. L26-FP-6

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 8189

SUPPLIER " " P.O. #

DATE ORDERED 1-19-61 REC'D/COMPLETED 2-14-61 DELIVERED

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1 mv to 10-100V. Response 10 Hz- 2 MHz
Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input 2 2M/9-19 pf

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	4	Eng	Devel. Lab	Semiconductors		2-14-61
West	4	Eng	318-816	G. Gifford		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)						

COMMENTS AND REVISIONS	DATE
1. Remarks 12-28-66 thru 3-6-69	

FINAL DISPOSITION	BY	

IN – None TAG NO. L26-FP-6

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71

TAG NO. L26-FP-7

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 8194

SUPPLIER " " P.O. # 58688

DATE ORDERED 1-18-61 REC'D COMPLETED 2-13-61 DELIVERED

WORK ORDER # E-4467 ASSIGNM'T # 42 ENGINEER P. Davidson

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION General purpose - engineering

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT

PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	2	Eng	Design	Engrg Specialist		2-13-61
West	4	Eng	318-810	R. Bergslien		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)

West	2			Davidson		1-71

COMMENTS AND REVISIONS	DATE

FINAL DISPOSITION BY

IN – None

TAG NO. L26-FP-7

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71 TAG NO. L26-FP-8

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL TYPE 310 A SERIAL 8426

SUPPLIER " " P.O. # 63181

DATE ORDERED 7-11-61 REC'D COMPLETED 7-25-61 DELIVERED

WORK ORDER # ASSIGNM'T # 42 ENGINEER W. R. Ayres

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 255.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION PART OF L48-HR-1 ANECHOIC ROOM INSTRUMENTATION SYSTEM

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV'FOREMAN	APPROVED BY	DATE
West	2	Eng	Comp. Eval.	H. Luecht		7-25-61
West	4	Eng	318-818	A. Petrie		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)						
West	2			Luecht		1-71

COMMENTS AND REVISIONS	DATE

FINAL DISPOSITION BY

IN – None TAG NO. L26-FP-8

69

HAMMOND ORGAN CO.

EQUIPMENT HISTORY

DATE 5-19-71

TAG NO. L26-FP-9

EQUIPMENT NAME AC-VTVM

MFR. Ballantine Labs MODEL/TYPE 310 A SERIAL 8586

SUPPLIER Lang, Claeson & Assoc. P.O. #

DATE ORDERED 8-9-61 REC'D/COMPLETED 9-14-61 DELIVERED

WORK ORDER # ASSIGNM'T # ENGINEER

ENGR'G HRS. MODEL SHOP HRS. MTL. COST TOTAL $ 250.00

PART/ASS'Y NO. PROCESSED ES

PART/ASS'Y NAME

PRODUCT USED IN: MODEL NAME

EQPT. FUNCTION Instrument repair - Standards Lab

EQPT. DESCRIPTION Log scales. Ranges .1-1mv to 10-100V. Response 10 Hz-2 MHz. Accuracy 3% of reading 10 Hz-1 MHz, 5% above 1 MHz. Input Z 2M/9-19 pf.

ASSIGNMENT						
PLANT	FL.	DEPT.	SECTION	SUPV/FOREMAN	APPROVED BY	DATE
West	2	Eng	Product Des			9-14-61
West	4	E.S.D.	Standards Lab	R. Holpuch		2-22-67
West	3	ETSE	Standards Lab	R. Holpuch		1-71

LOCATION – IF NOT AS ASSIGNED (USE PENCIL ONLY)						
				E.C Kennedy		1-71

COMMENTS AND REVISIONS	DATE

FINAL DISPOSITION BY

IN – None

TAG NO L26-FP-9

69

16517

DEPARTMENT HEAD
DIVISION HEAD
GENERAL MANAGER
CONTROLLER
PURCHASING AGENT

PLEASE CHECK AND FORWARD TO NEXT ON LIST

HAMMOND ORGAN CO.

PURCHASE REQUISITION

Date

Soon as possible

Ballantine Labs.
c/o Lang, Claeson & Assoc.
6733 N. Olmsted Ave.
Chicago 31, Ill

P.O. No. 30-61

Dated 6 3 / 8 1

Via 7-11-61

te Wanted

ip to ☐ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

ANTITY	DESCRIPTION	THIS SPACE FOR PURCHASING DEPT. ONLY
1	Ballantine Lab. Electronic Voltmeter "Rack"	
	Type 310A-S2 255.00	
	L26-FP-8	

7-18-61

Get.

B. TERMS:

ll requisitions covering major machinery and equipment, please fill in:

ATION: PLANT Western, FLOOR 2; DEPARTMENT Elect. Design

rer to W.Inglis Comp. Eval.Sect. 42

ation of: Charge

Approved Authorized

200 15M 5-59 81553

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. L26-FP-9 E. NO. _____ FILE _____

TITLE Vacuum Tube Voltmeter, A.C.

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8586

DESCRIPTION 100 Microvolts to 100 Volts in 6 ranges; 10 cycles to 2Mc;
Accuracy 3% to 1Mc, 5% above.

MANUFACTURER Ballantine Labs.

SUPPLIER Lang, Claeson & Assoc.

COST $250.00 DATE ORDERED 8-9-61 DATE RECEIVED 9-14-61
DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT: Western FLOOR 2nd DEPT. Prod. Design

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED General purpose

IN NOS. PERTAINING TO TEST Manufacturer's instructions

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE

(01-001)

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. L26-FP-6 E. NO. _____ FILE WESTERN DEVEL. DEPT. 4TH FL.

TITLE Meter; AC Volt

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8189

DESCRIPTION Voltage range: 100μvolt to 100 volts in 6 decade ranges (.001, .01, .1, 1, 10, 100) volts full scale. Freq. range 10 cps to 2 MC. Accuracy: 3% from 10 cps. to 1 MC. 5% above 10 megacycle. Input impedance: 2 megohms

MANUFACTURER Ballantine Lab., Inc. Boonton, New Jersey

SUPPLIER Lang, Clason & Assoc., 6733 N. Olmstead, Chicago 31, Ill.

COS $250.00 DATE ORDERED 1/19/61 DATE RECEIVED 2/14/61 DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT Western FLOOR 4 DEPT. Devel. Eng. (Semiconductor Sect.)

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED General purpose

IN NOS. PERTAINING TO TEST. Instruction book supplied by manufacturer

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE

(01-001)

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. L26-FP-7 E. NO. _____ FILE WESTERN DESIGN (ASSEM. DES. SECT.), 2ND FL.

TITLE Meter; AC Volt

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8194

DESCRIPTION Voltage range: 100μ volt to 100 volts in 6 decade ranges. (.001, .01, .1, 1, 10, 100) volts full scale. Freq. range 10 cps. to 2 MC. Accuracy: 3% from 10 cps. to 1 MC. 5% above 1 megacycle. Input impedance: 2 megohms

MANUFACTURER Ballantine Lab., Inc. Boonton, New Jersey

SUPPLIER Manufacturer

COST $250.00 DATE ORDERED 1/11/61 DATE RECEIVED 2/13/61 DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT Western FLOOR 2 DEPT. Elect. Design (Assembly Design Sect.)

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED

General purpose

IN NOS. PERTAINING TO TEST Instruction book supplied by manufacturer.

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE

(01-001)

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. L26-PT-8 E. NO. _____ FILE _____

TITLE Meter; A.C. Vacuum Tube Volt

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8426

DESCRIPTION Voltage range: 100μ volts to 100 volts in 6 decade ranges. Frequency range: 10 cps. to 2MC. Accuracy: 3% from 10 cps. to 1 MC. 5% above 1 megacycle. Input impedance: 2 megohms.

MANUFACTURER Ballantine Lab., Inc., Boonton, N.J.

SUPPLIER Manufacturer

COST $255.00 DATE ORDERED _____ DATE RECEIVED 7-25-61 DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT: Western FLOOR 2nd DEPT. Design (Comp. Eval. Sect.)

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED General purpose.

IN NOS. PERTAINING TO TEST. Instruction book supplied by manufacturer.

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE

(01-001)

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. 126-TT-9 E. NO. _____ FILE _____

TITLE Vacuum Tube Voltmeter, A.C.

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8506

DESCRIPTION 100 Microvolts to 100 Volts in 6 ranges; 10 cycles to 2Mc;
Accuracy 3% to 1Mc, 5% above.

MANUFACTURER Ballantine Labs.

SUPPLIER Lang, Claeson & Assoc.

COST $250.00 DATE ORDERED 8-9-61 DATE RECEIVED 9-14-61
DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT: Western FLOOR 2nd DEPT. Prod. Design

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED General purpose

IN NOS. PERTAINING TO TEST. Manufacturer's instructions

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE

(01-001)

HAMMOND ORGAN COMPANY — TEST LABORATORY

TO: ENGINEERING TEST LABORATORY — DATE Sept 9, 1960

FROM:
- ☐ PRODUCTION DEPT.
- ☐ INSPECTION DEPT.
- ☒ ENGINEERING DEPT.
- * ☐ _____ * FOR OTHER DEPARTMENTS

○ REQUEST FOR NEW TEST EQUIPMENT.

COMPONENT OR ASSEMBLY NO. TO BE TESTED _____

DATE REQUIRED _____

⊗ REQUEST FOR MODIFICATION OR REPAIR OF TEST EQUIPMENT

EL NO. L-26FP-3 M-NO. _____ DATE REQUIRED Rush

○ REQUEST FOR INSTRUMENT CALIBRATION

EL NO. _____ M-NO. _____ DATE REQUIRED _____

○ MISCELLANEOUS

_____

REASON FOR REQUEST AND OR NATURE OF COMPLAINT

Meter has stopped reading although fuse did not blow.

PREPARED BY _____ APPROVED _____ 9/9/60

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY ( ) ROUTINE

DESCRIPTION OF EQUIPMENT Ballantine llC VTVM model 310A

~~EL~~ NO. L26-FP-3 M - NO. _____ LOCATION Western, Eng (Devel. Lab), 4th fl.

DATE 9/13/60 TIME NOTIFIED 9/9/60 REPORTED BY W. Fauble Jr.

NATURE OF COMPLAINT: No meter reading with a signal applied

ANALYSIS: Measured voltages and found V1 & V2 not conducting. Measured V7 (OA2) voltage and found low voltage instead of 150 Volts.

REMEDY: Replaced the OA2 with a new one. checked cal found OK.

TIME REQUIRED TO SERVICE EQUIPMENT 1½ hr. COST OF MATERIALS $2.50

TOTAL TIME EQUIPMENT NOT IN USE 1½ hr PREPARED BY E. Kurtz

QL-005

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY ( ) ROUTINE

DESCRIPTION OF EQUIPMENT Ballantine VTVM MOD 310A

L 76-FP-4

~~EL NO.~~ _____ M - NO. _____ LOCATION Western Develop Lab-

DATE APR 21 1961 TIME NOTIFIED _____ REPORTED BY Van Leer

NATURE OF COMPLAINT: Erratic readings

ANALYSIS: Volt selector switch is dirty.

REMEDY: Removed cleaned & lubricated Volt selector switch. Assembled checked operation OK.

TIME REQUIRED TO SERVICE EQUIPMENT 12 hrs COST OF MATERIALS _____

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY E. Zabel

Q1-005

Shipment Lab. Received 8-29-60
Ballantine Lab Inc Boonton N.J.

HAMMOND ORGAN COMPANY — TEST LABORATORY

TO: ENGINEERING TEST LABORATORY

DATE 3-21-1961

FROM:

☐ PRODUCTION DEPT.

☐ INSPECTION DEPT.

☑ ENGINEERING DEPT.

* ☐ _____ * FOR OTHER DEPARTMENTS

◯ REQUEST FOR NEW TEST EQUIPMENT.

COMPONENT OR ASSEMBLY NO. TO BE TESTED _____

DATE REQUIRED _____

☑ REQUEST FOR MODIFICATION OR REPAIR OF TEST EQUIPMENT

Ballantine Voltmeter

EL NO. 26-FP-4 M-NO. _____ DATE REQUIRED S.A.P.

Mod. 310A Ser. 7706

◯ REQUEST FOR INSTRUMENT CALIBRATION

EL NO. ~~26-FP-4~~ M-NO. _____ DATE REQUIRED _____

◯ MISCELLANEOUS

REASON FOR REQUEST AND OR NATURE OF COMPLAINT

NEEDLE JUMPS WHEN SWITCHING RANGES.

PREPARED BY Jason Leer APPROVED J.J.

AMMOND ORGAN COMPANY

TO: ☐ PRODUCTION DEPT.

☐ INSPECTION DEPT.

DATE 6-8-61

FROM: ENGINEERING DEPT.

◯ REQUEST FOR CHANGE IN PROCEDURE OR METHODS

◯ REQUEST FOR FIXTURE OR TOOL REPAIR

⊗ MISCELLANEOUS

ART NO. _____ DESCRIPTION BALLENTINE VTVM

MODEL 310A L26-FP-5

REASON FOR REQUEST ERRONEOUS READINGS. DISCOVERED ON 0-10V SCALE

3-10V scale reads 50 MV low to 3V and 100 MV low to 10V - thus is within tolerance (150 MV)

PREPARED BY Gary Kupke

APPROVED W H Rieger

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT Ballantine VTVM, Mod 310A

EL NO. L26-FP-5 M - NO. _____ LOCATION Eng. Deft.

DATE 6-8-61 TIME NOTIFIED _____ REPORTED BY G. KAPKE
W. H. RIEGER

NATURE OF COMPLAINT: Erroneous readings on 0-10V scale

ANALYSIS: Checked calibration - reads 50 MV low to 3V and 100 MV low to 10V, then is in tolerance (100 MV)

REMEDY: None - returned to Inspect 23 Jan 61

TIME REQUIRED TO SERVICE EQUIPMENT 1/2 hr. COST OF MATERIALS None

TOTAL TIME EQUIPMENT NOT IN USE 14 days PREPARED BY RH

☐ GENERAL MANAGER
☐ CONTROLLER
☐ PURCHASING AGENT

Soon as possible — FORWARD TO NEXT ON LIST

Lang, Claeson & Assoc.
6733 N. Olmstead
Chicago 31, Ill.

SP4-3612

P. O. No. 8-9-61

Date Wanted

Dated 64640

Ship to ☒ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

Via 8-31

QUANTITY	DESCRIPTION		THIS SPACE FOR PURCHASING DEPT. ONLY
1	Ballantine Model 310A A.C. Meter	250.00	
	L 26-FP-9		

F. O. B.

TERMS:

On all requisitions covering major machinery and equipment, please fill in:

LOCATION: PLANT Western, FLOOR 3; DEPARTMENT Elect. Design

Deliver to Attention of: R. Watterlohn

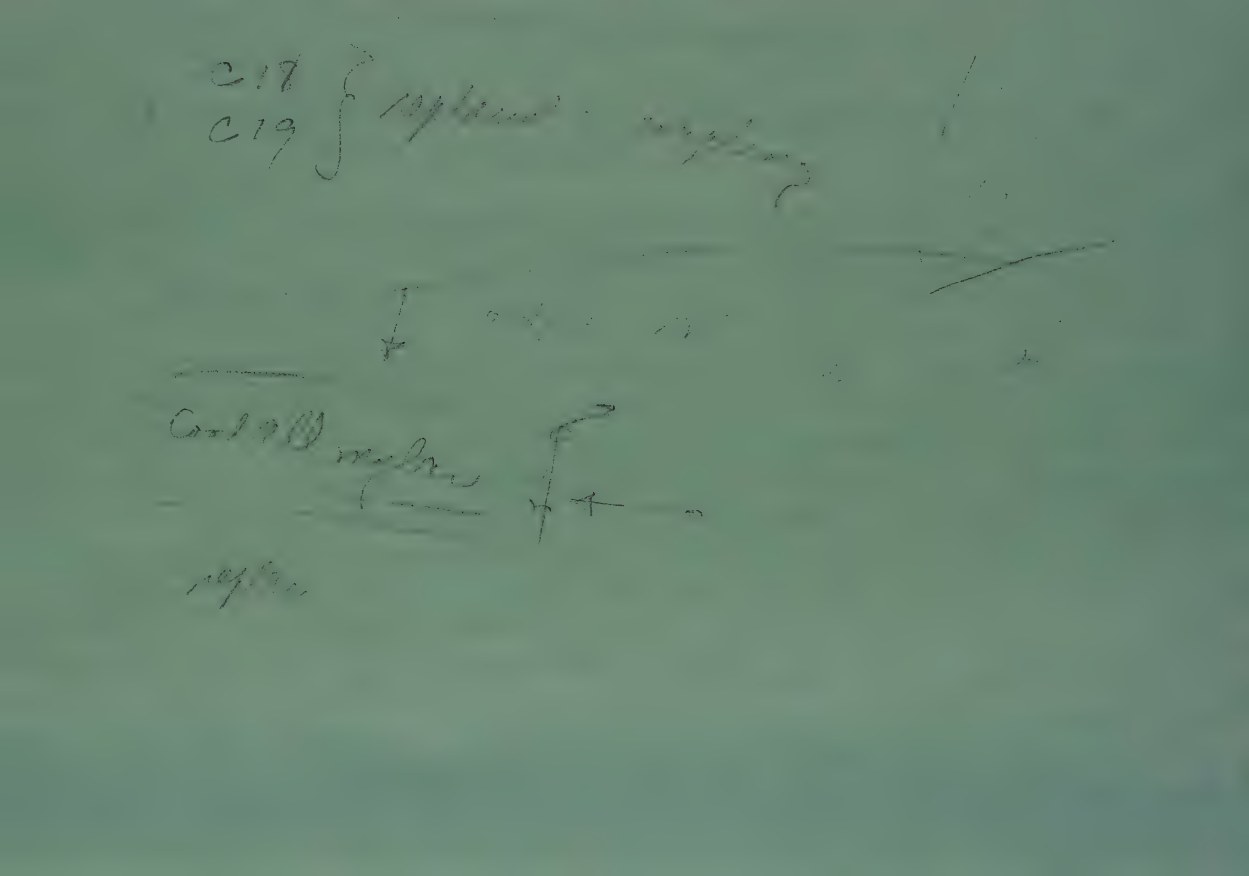
Charge 42

Signed

Approved

Authorized

FORM P-200 15M 5-59 81553



☐ PURCHASING AGENT / ☐ ON LIST

6733 N. Olmstead
Chicago 31, Illinois

P. O. No. 73147

Date Wanted

Dated 5-8-62

Ship to ☒ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

Via

QUANTITY	DESCRIPTION	This Space For Purchasing Dept. Only
1	Instruction Manual, Electronic Voltmeter, Ballantine, Type 310A $2.00 or n/c	1.50

Rec'd 5-23-62

REQUESTED BY COMPONENTS EVALUATION SECTION

F. O. B.

TERMS:

On all requisitions covering major machinery and equipment, please fill in:

LOCATION: PLANT Western, FLOOR 2nd; DEPARTMENT Electrical Design

Deliver to R. Holpuch

Attention of E-5094 Charge 555

Signed Approved Authorized

FORM 04-013 15M

HAUTAU & OTTO CHICAGO 44, ILLINOIS

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT BALLANTINE MODEL [illegible]

EL NO. L26-FP-9 M - NO. _____ LOCATION [illegible]

DATE 7 [illegible] TIME NOTIFIED _____ REPORTED BY [illegible]

NATURE OF COMPLAINT: METER READING. DOES [illegible]

ANALYSIS: ABOVE [illegible] for only short [illegible] analyze, [illegible] off and on without [illegible]

REMEDY: SENT INSTRUMENT [illegible] for WARranty [illegible] on 7/10/52 [illegible]

TIME REQUIRED TO SERVICE EQUIPMENT _____ COST OF MATERIALS _____

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY [illegible]

☐ CONTROLLER
☐ PURCHASING AGENT

TO NEXT ON LIST

Boonton, New Jersey

P. O. No.

Date Wanted

Dated 75059

Ship to ☐ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

Via 7-11-62

QUANTITY	DESCRIPTION	This Space For Purchasing Dept. Only
1	Ballantine Model 310A S/2 A.C. Meter, S/N 8426	
	Hammond Organ Company No. 126-FT-8	
	To be shipped to Attention: Mr. Frank Zayac	
	Ballantine Laboratories, Inc.	
	Boonton, New Jersey	
	For Warranty Repair	
	called 7/20/62	
	Telcon. Mr. Lang (Mfr's Rep.) should [illegible]	
	Lang, Claeson & Assoc.	
	6733 N. Olmstead	
	Chicago 31, Illinois	
	SP 4-3610	
	PICK UP IN ELECTRICAL EQUIPMENT DEPARTMENT	

F. O. B.

TERMS:

On all requisitions covering major machinery and equipment, please fill in:

LOCATION: PLANT Western, FLOOR 2nd; DEPARTMENT Electrical Equipment

Deliver to

Attention of E. Kurtz

E-5094 80210 552

Charge

Signed

Approved

Authorized

FORM 04-013 15M

HAUTAUX OTTO CHICAGO 44, ILLINOIS

July 10, 1962

Ballantine Laboratories, Inc.
Boonton, New Jersey

Attention: Mr. Frank Zayac

Dear Mr. Zayac:

Subject: Ballantine Meter, Model 310A, S/N 8426

Low frequency response drops off below 200 cps. intermittently while frequencies above this value are all right. Meter works properly most of the time. Meter would go out for short periods, five minutes or more, per eight hours.

Very truly yours,

HAMMOND ORGAN COMPANY

Eugene Kurtz
Standards Laboratory
Electrical Equipment Department

CC: Central File

T COPY

PURCHASE ORDER

MMOND ORGAN
ic's most glorious voice"

HAMMOND ORGAN COMPANY

2915 N. WESTERN AVENUE - CHICAGO 18, ILLINOIS - BRunswick 8-4100

DATE JULY 12, 1962

PURCHASE ORDER No. 75059

THIS ORDER TO CONSIST OF 1 PAGE UNLESS MARKED: PAGE ____ OF ____

GALLANTINE LAB., INC.

BOONTON, NEW JERSEY

2915 N. WESTERN AVENUE, CHICAGO 18, ILLINOIS VIA BEST WAY

DESCRIPTION OF ARTICLES	PRICE
RUSH REPAIR UNDER TERMS OF WARRANTY GALLANTINE MODEL 310A S/Z A.C. METER, S/N 8426 HAMMOND ORGAN COMPANY NO. L26-FP-8 PER 13901 FOR WARRANTY REPAIR file ABOVE BEING SHIPPED TO YOU ON OUR SHIPPER P-22613 DATED JULY 12, 1962.	N/C NOT FOR RESALE

ZEDLER

E. KURTZ [illegible]

VERY ____ CHARGE ____ AUTH. ____

OUR PLANT TERMS NET

DATE RECD	BALANCE DUE	QUANTITY	DATE RECD	BALANCE DUE	QUANTITY	DATE RECD	BALANCE DUE

0282

HAMMOND ORGAN COMPANY

ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT BALLANTINE MODEL 310A AC VTVM

EL NO. L26-FP-4 M - NO. _____ LOCATION MASTER DEVEL ENG 4th fl, A E EM SEC'T.

DATE 12/6/62 TIME NOTIFIED _____ REPORTED BY E. Kurtz

NATURE OF COMPLAINT: Meter reading drops 5% when line voltage is varied from 117 volts to 125 volts

ANALYSIS: checked tubes on tube tester & found V. (5Y4) weak.

REMEDY: Changed 5Y4 tube and V. (5Y4) calibrated & found satisfactory

TIME REQUIRED TO SERVICE EQUIPMENT 1 hour COST OF MATERIALS $2.25

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY E. Kurtz

MENT HEAD
N HEAD
AL MANAGER
OLLER
ASING AGENT

PLEASE CHECK AND FORWARD TO NEXT ON LIST

HAMMOND ORGAN CO.

PURCHASE REQUISITION

22997

Date

Radio Distributing Co., Inc.
5144 W. Madison Street
Chicago 44, Illinois ES-9-2121

P. O. N 1/2/63

Dated 29350

Via 1-4-62

nted

☐ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

Y	DESCRIPTION	This Space For Purchasing Dept. Only
	Transitron, Type 3530 - Crystal Diode $1.70 Ea.	
	Replacement Parts for Ballantine - Model 310A - AC VTVM	
	confirming Order 1-3-63/ Mr. K Lauda Del 1-4-63.	

TERMS:

isitions covering major machinery and equipment, please fill in:

N: PLANT Western, FLOOR 2nd; DEPARTMENT Elect. Equipt.

f E. Kurtz Charge E-5094

Approved Authorized

HAUTAU & OTTO CHICAGO 44, ILLINOIS

HAMMOND ORGAN COMPANY — ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT Baltimore 310A Amp

~~EE~~ NO. 126-FP-2M - NO. _____ LOCATION Western Amp

DATE 12/17/62 TIME NOTIFIED _____ REPORTED BY D. Sta...

NATURE OF COMPLAINT: Low fuse Expense Low Cost

ANALYSIS: Above complaint true. Input would open fuses short intervals, monitor note out from Speaker after the first 2 days. Called Customer about remote which was found defective. Set No and the changed C18 & C9 complete amplifier. Tried but substituted in their case but Set trouble would not occur as the result of that.

REMEDY: Changed C18 (.033) and C9 (.1 mf) anode bypass voltage rating unless otherwise specified. Tube and could not get Input to overload Speaker. Changed S-536 diode in output - Tested OK - then returning

TIME REQUIRED TO SERVICE EQUIPMENT 1 hr COST OF MATERIALS $ .20

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY E. Wentz

AJ-305

0412

DIAMOND ORGAN COMPANY

ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT BALLANTINE Model 310-A AC VTVM

~~EL~~ NO. L26-FP-3 M - NO. _____ LOCATION Western Dev. Lab. Sch...

DATE 4/19/63 TIME NOTIFIED 3/13/63 REPORTED BY R. Schreengost.

NATURE OF COMPLAINT: (1) SCALE switch intermittent, poor contact.

ANALYSIS: (1) Sw. Contact Poor

REMEDY: (1) Sprayed switch contacts with Walsco.
(2) Checked all other functions and found OK
(3) Replaced #47 lamp between (1) and (2) (Note: original was burned out)
(4) Checked calibration and found adjustable

TIME REQUIRED TO SERVICE EQUIPMENT 1 Hr. COST OF MATERIALS $ 2.20

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY E. Kurtz

0424

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT BALLANTINE AC VTVM Model 300

EL NO. L26-FP-1 M - NO. _____ LOCATION Western Electric Eng. 2nd fl

DATE 5-10-63 TIME NOTIFIED 3-27-63 REPORTED BY N. Rubb

NATURE OF COMPLAINT: Reading fell off on Frequency

ANALYSIS: Checked tube [illegible] and found 1-(5-5-) low in Gm. Ran test which showed that the [illegible] unit on a good beginning value at [illegible] Checked unit to C18 & C19. Wanted meter for [illegible] Temple but was not [illegible]

REMEDY: Replaced 1x(5-5-) with new one. Placed [illegible] Calibrated & returned meter.

TIME REQUIRED TO SERVICE EQUIPMENT 4 hr COST OF MATERIALS $ 3.25

TOTAL TIME EQUIPMENT NOT IN USE — PREPARED BY E. [illegible]

81-305

0516

HAMMOND ORGAN COMPANY ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( )EMERGENCY ( )ROUTINE

DESCRIPTION OF EQUIPMENT

EE NO. L26-EE-9 M - NO. LOCATION

DATE TIME NOTIFIED REPORTED BY

NATURE OF COMPLAINT:

ANALYSIS:

REMEDY:

TIME REQUIRED TO SERVICE EQUIPMENT COST OF MATERIALS

TOTAL TIME EQUIPMENT NOT IN USE PREPARED BY

File 126 FP-3

October 2, 1963

Ballantine Laboratories, Inc.
Boonton, New Jersey

Attention: Service Department

Gentlemen:

On the recommendation of your local representative, Lang, Claeson & Assoc., we are sending to you for repair a Model 310A, Serial No. 7383.

Of nine 310A meters in our laboratories, four have developed the same trouble at some time or other. In one case, a meter was returned to you for repair, and we do not know the corrective measures taken. In another instance, your local representative suggested replacing the coupling capacitors, C18 and C19. This was done, but with considerable difficulty, due to parts inaccessability. The meter appeared to be operating correctly. In another case, a weak tube was replaced and the trouble did not reappear.

The point of all this is that our repairs were hit-or-miss, with no real confidence that a repair was made, and we are hesitant to continue on this basis, due to the great difficulty of replacing the coupling capacitors. Also, we can expect this problem to occur from time to time in the meters that have not been repaired correctly or have not yet failed. We also do not relish the prospect of returning each meter to you each time a failure occurs. Too many times we receive the repaired equipment damaged in transit, requiring considerable additional trouble and expense.

Perhaps you might clarify the problem for us, so that we might have sufficient confidence that we are making the correct repair and thereby justify the time and effort it requires to replace coupling capacitors in the future.

The unit we are sending to you has an intermittent condition where, after about one-half hour of operation, the low frequency response drops off. After about five minutes, it returns to normal again. Any attempts to analyze the condition restores proper operation and further attempts are futile. We would appreciate hearing from you on this matter.

Very truly yours,

HAMMOND ORGAN COMPANY

R. Holpuch,
Standards Lab. Supvr,
Engineering Services Dept.

RH/md

Dear Sir,

Reference No. 3/2

Date: 15th January, 1962

Subject: Delivery Instructions

Please deliver the following goods to the above address:

1 Model 710A Signal Generator, Serial No. 1042

Packing: Standard export crate

Delivery: Ex stock, Melbourne

Terms: Net 30 days

Please arrange delivery as soon as possible.

Yours faithfully,

J. Mitchell
Purchasing Officer

BALLANTINE LABORATORIES, INC.
Precision Electronic Measuring Equipment
BOONTON, NEW JERSEY

AREA CODE 201
TEL. 334-1432
TWX. 334-8961

November 12, 1963

Mr. R. Holpuck
Hammond Organ Company
4200 West Diversey Avenue
Chicago 39, Illinois

Dear Mr. Holpuck:

The problem you describe in your letter of October 2nd concerning the intermittent low frequency response of your 310A's has occurred rather infrequently in the past to other customers.

It would be impossible to state definitely here which component is at fault since there are many which could give you this problem. However, through past experience, I can tell you which components are usually at fault:

1) Coupling Capacitors C11, C18 and C19.
2) Output Amplifier Tubes. Use GE five star tubes.
3) R33 Output Amplifier Feedback Resistor.
4) Screen bypass capacitors C9A&B, C17A&B.

In troubleshooting the instrument, attempts should be made to determine which Amplifier is shifting by monitoring the signal at pin 5 of V2. If the monitored indication changes the trouble is in the input amplifier. If it does not, the output amplifier is at fault.

To determine which stage of amplification is at fault, short out the feedback resistors R11 and R33. (Short out R11 by using a 100 uF capacitor). When the defective stage is discovered the component at fault can usually be found by heating or probing.

If this procedure proves to be inconvenient for you I would suggest that you return the instrument to us enclosing a complete description of the difficulties. Please be sure that it is well packed with plenty of cushioning and return it to us by any means except.....Parcel Post.

Very truly yours,

BALLANTINE LABORATORIES, INC.,
Robert W. Schicke
Robert W. Schicke

rws/fcw

L26-FP-3

INSTRUCTIONS FOR

ELECTRONIC VOLTMETER

MODEL 310A

BALLANTINE LABORATORIES, INC.
BOONTON, NEW JERSEY

INSTRUCTIONS FOR

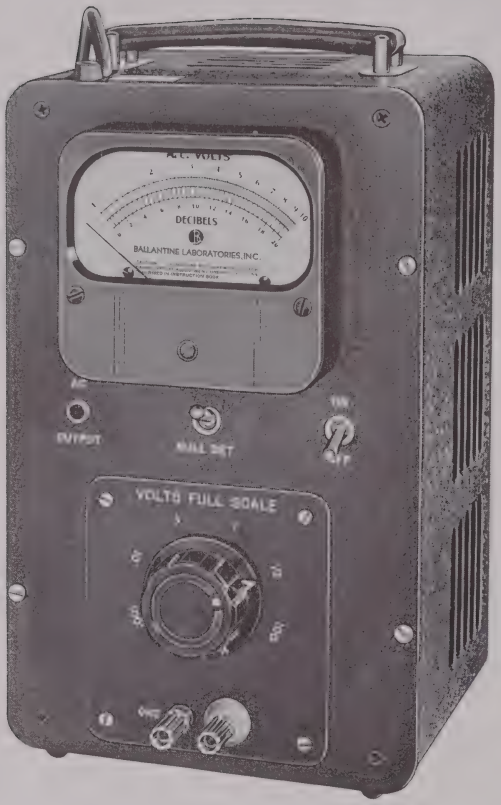
ELECTRONIC VOLTMETER

MODEL 310A

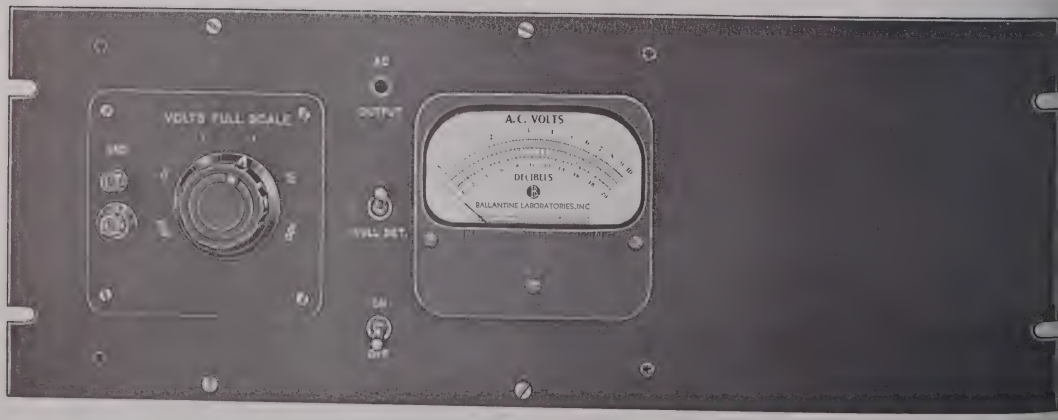
BALLANTINE LABORATORIES, INC.
BOONTON, NEW JERSEY

PRINTED IN U.S.A.

3/62 Y



Model 310A Electronic Voltmeter



Rack Panel Mounted — Model 310A-S/2

CONTENTS

	Page
Specifications	4
General	5
Circuit Arrangement	5
Basic Operation	5
Measurement Below 100 Microvolts and above 100 Volts	5
Measurement of Voltages at Line Frequency	6
Input Impedance	6
Overload Characteristics	6
Effect of Waveform	6
Scale Range Adjustment	6
Meter Adjusting Screw	7
Calibration Adjustment	7
Use as a Null Detector	7
Use as an Amplifier	7
Power Level Measurements	8
Measurement of Current	8
Servicing	8
Replacement of Tubes	8
Warranty	9
Replacement Parts List	10-11-12
Schematic Diagram	

SPECIFICATIONS

BALLANTINE MODEL 310A ELECTRONIC VOLTMETER

Voltage Range

Direct reading from 100 microvolts to 100 volts in 6 decade ranges.
(.001, .01, .1, 1, 10, 100 volts full scale)
Measurements may be made down to 40μV at reduced accuracy when employing null detector feature. Threshold sensitivity of null detector is 10 μV.

Frequency Range

10 cps to 2 Mc for voltage measurement.
5 cps to 4 Mc as bridge null detector.

Accuracy

In range 100 microvolts to 100 volts:
3% from 10 cycles to 1 megacycle; 5% above 1 megacycle
at any point on the meter scale.

Input Impedance

Range Switch Setting	Input Impedance
0.001 V and 0.01 V Ranges	2 megohms shunted by 19 pF
0.1 V Range	2.2 megohms shunted by 9 pF
1 V, 10 V and 100 V Ranges	2 megohms shunted by 9 pF

Above audio frequencies shunt resistance diminishes owing to inherent properties of all resistors having finite physical dimensions.

Scales

Logarithmic voltage scale (illuminated) reading from 1 to 10;
Linear decibel scale reading from 0 to 20
Each meter is hand calibrated.

Amplifier Characteristics

Maximum voltage gain of 60 DB, adjustable by means of range switch to 40 or 20 DB. Output impedance 500 ohms. Maximum output voltage 1 volt. Flat within ½ DB from 10 cps to 2 Mc.

Power Supply

105-125 (or 210-250) volts, 50-400 cycles, 35 watts.

Tubes

Five Type 5654; two Type OA2; one Type 6X4.
All tubes supplied.

Dimensions

Portable: 6¾″ wide, 6″ high, 10⅞″ long.
Rack Mounted: 19″ wide, 6¾″ high, 6″ deep.

Weight

11 pounds, net. Shipping weight 16 pounds.

INSTRUCTIONS FOR
BALLANTINE MODEL 310A
ELECTRONIC VOLTMETER

GENERAL — This instrument is designed to measure sinusoidal voltages from 100 microvolts to 100 volts over a frequency range from 10 cycles to 2 megacycles. It operates from a 105-125 (or 210-250) volt 50 to 400 cycle power supply.

By means of a six decade range switch, the entire voltage range is indicated on a single logarithmic voltage scale reading from 1 to 10. The meter has a uniform decibel scale numbered from 0 to 20 decibels. The zero of the decibel scale is arbitrarily arranged for maximum usefulness so as to correspond to 1 on the voltage scale.

Its accuracy is 3% up to 1 megacycle and 5% above 1 megacycle.

Although the meter zero is suppressed a switch is provided for obtaining an on-scale reading when no signal is applied to the voltmeter, and this feature permits its use as a sensitive null indicator while also providing means for measuring levels below 100 microvolts down to 40 microvolts.

An AC output jack permits the amplifier section of the voltmeter to be used as a flat pre-amplifier with gains of 20, 40 or 60 DB depending on the setting of the range switch.

CIRCUIT ARRANGEMENT — The voltmeter employs a resistance-capacity decade attenuator, two negative feedback amplifier units, a full wave crystal diode rectifier and a logarithmic indicating meter responding to the average values of the voltage wave but calibrated in rms values of a sine wave. Each of the amplifier units has sufficient feedback to render the indications of the instrument substantially independent of changes in line voltage, tubes and other circuit components. Part of the range switch attenuator is placed between the two amplifier units thereby reducing tube noise, hum and microphonics to a minimum. For further circuit details see the attached diagram.

BASIC OPERATION — The voltmeter is supplied with tubes and is ready to operate as received. It is only necessary to plug the line cord into the specified AC power source and turn on the switch marked "ON-OFF." The illuminating lamps incorporated in the indicating meter serve as pilot lights to indicate when the power is on.

The input terminal marked GND is connected to the case of the voltmeter. In order to avoid the introduction of extraneous voltages between the two points whose potential difference is under measurement, the input terminal marked GND should, whenever possible, be connected to the ground of the circuit in which a voltage is being measured.

In order to avoid extraneously induced voltages when operating on the more sensitive ranges, the input leads to the voltmeter should be as short as possible and should be shielded if the consequent increase in capacitance can be tolerated. This also applies to the binding post connections and hence it is recommended that for measurements in which the avoidence of pick-up is imperative the General Radio shielded head assembly, Type 274-ND ,be employed.

Measurements in the range 100 microvolts to 100 volts are easily made by reference to the range switch position and the reading on the single voltage scale. The position of the range switch indicates the voltage input to yield full scale deflection of the indicating meter.

For best accuracy the portable version of the voltmeter should be arranged with the scale of the meter situated in the horizontal place for which position the specified accuracy figures are applicable. A degradation of accuracy by not more than 1% may occur if the instrument is used in any other position owing to unavoidable limitations of moving coil movements. In the case of rack-mounted voltmeters the specified accuracies apply for the vertical position of the panel.

MEASUREMENT BELOW 100 MICROVOLTS AND ABOVE 100 VOLTS — Although the NULL DET switch is designed for use with AC bridges, as described below, it can be employed for extending the range of the voltmeter from 100 μV down to 40 μV. The error in this region will be no greater than 10%. Whenever the pointer falls below the scale on the .001 range, depress the NULL DET switch and note the reading in microvolts. Subtract from this reading the deviation introduced by the NULL DET switch, as described below. The resulting difference represents the voltage applied to the voltmeter input. To compute the deviation introduced by the NULL DET switch, connect a signal to the voltmeter input sufficient to obtain an up-scale reading. Any range of the voltmeter can be used, and the source can be of any frequency within the range of the instrument. Ex-

press the reading in microvolts as though the instrument was on the .001 range. Now depress the NULL DET switch and again express the resulting reading in microvolts. The difference between these two readings is the deviation introduced by the NULL DET switch.

Voltages less than 100 microvolts over the range from 10 to 150,000 cycles may be measured directly with this voltmeter by using it in conjunction with the Ballantine Model 220C Decade Amplifier.

For measurements above 100 volts (200 volts in the case of the Model 310A-S/3) the Ballantine Models 1310A and 1310B Multipliers permit an increase in range to 1000 volts and 10,000 volts, respectively.

MEASUREMENT OF VOLTAGES AT LINE FREQUENCY — Even though the amount of residual hum in the voltmeter is negligible in relation to normal measurements, it may introduce slight errors when the voltmeter is used to measure voltages giving indications at the lower end of the meter scale and having a frequency synchronous with that of the AC supply. Errors due to this condition will not exceed ½% on all range settings except the .001 range where up to 3% is possible. These inaccuracies may be reduced by making two measurements, one with the power plug in normal polarity and the other with the power plug reversed. The mean of these readings will represent the true value of the voltage being measured.

INPUT IMPEDANCE — The input impedance of the voltmeter depends somewhat on the setting of the range switch as shown by the tabulation in the specifications on page 3.

Any direct current component of the wave under measurement is kept out of the voltmeter by means of a series blocking condenser in the input circuit of 600 volts DC rating. If it is desired to measure the AC or ripple component of a wave whose DC component exceeds 600 volts an auxiliary network should be employed. This may consist of a series condenser of at least 0.15 μF (with a voltage rating at least equal to the DC component of the wave under measurement) and a resistor of at least 5 megohms in shunt. An example of the use of such a network would be for the measurement of the commutator ripple on a 650 volt DC generator.

OVERLOAD CHARACTERISTICS — The amplifier circuits are designed to saturate promptly when the voltage exceeds the full scale indication of the meter, thus protecting the meter movement. This is of considerable advantage over other meters which may be seriously damaged by overloads such as the Model 310A will withstand. Overloads amounting to several hundred to one can be safely withstood on the lower ranges, while on the 10 and 100 volt ranges the maximum safe voltage is 400 volts.

EFFECT OF WAVE FORM — The indications of this voltmeter are proportional to the average value of the AC wave under measurement. Since, however, it is primarily intended to measure sinusoidal waves its calibration is in terms of the rms value of a sinusoidal wave. Since electronic voltmeters of the input diode rectifier type respond to the peak values of a wave, the readings of such a meter and the present voltmeter will not necessarily agree when harmonics are present. The amount of the discrepancy will depend on the number and magnitude of the harmonics present as well as their phase relationship with respect to the fundamental. In all cases, however, the departure of the readings from true rms values due to the presence of harmonics will be considerably less with an average responding meter such as the Model 310A than with a peak responding meter. For example, in the case of a third harmonic whose amplitude is 20% of the fundamental the maximum error of a peak responding meter may be as much as 20% whereas the maximum error of an average responding meter such as the Model 310A will never exceed 6.7%.

Inasmuch as the Model 310A voltmeter responds to the average value of the AC wave, "turn-over" discrepancies occasioned by any lack of symmetry of the wave such as are experienced in half-wave peak reading instruments are minimized, provided the crest factor of the wave does not exceed 2 when readings are being made at full scale. For lower readings the crest factor limit is increased in inverse proportion to the ratio of the reading and full scale deflection.

SCALE RANGE ADJUSTMENT — Under normal conditions a voltage which produces a scale reading of 10 will, when reduced by 90% (i.e. in the ratio of 10 to 1), produce a scale reading of 1. Ordinarily no adjustment should be necessary except at very infrequent intervals, but if some discrepancy is noted an adjustment accurate to approximately 1% may be made as follows: Allow the voltmeter to warm up for at least five minutes. Connect to the input a stable AC source of about 10 volts, of less than 1% distortion, and of any convenient frequency from 100 to 10,000 c.p.s. Adjust the amplitude so that the meter reads full scale (10) on the 10 volt range. Switch to the 100 volt range. The meter should now read 1. If not,

the red adjusting screw on the indicating meter should be rotated until it does. Switch back to the 10 volt range, to see whether the meter still reads 10. If not, readjust the input voltage to read 10 and then switch back to 1, readjusting the red screw if necessary. If it is not convenient to obtain a source of 10 volts the 1 and the 10 volt ranges may be similarly used to make this adjustment by using a source of 1 volt. (Since the input resistance of the voltmeter on the 0.1 volt range is slightly higher than on the other ranges the use of this range is not recommended in making this range adjustment unless the impedance of the voltage source is less than 50,000 ohms.)

If greater accuracy than that indicated above is desired it is recommended that the scale range adjustment be made on a single range of the voltmeter by using an external precision 10:1 potential divider which presents to the voltmeter a source impedance of not more than 2,000 ohms. The procedure would then be as outlined above except that level changes would be made with the potential divider and not the voltmeter range selector switch.

METER ADJUSTING SCREW — In the past some users have misunderstood the purpose of the red adjusting screw on the case of the indicating meter and have tried to use it either to bring the pointer to 1 on the scale with no voltage applied to the voltmeter input terminals, or to change the calibration of the voltmeter, instead of realizing that its *sole* function is to effect the scale range adjustment as described in the preceding section. The indicating meter, being logarithmic, has a suppressed zero and the normal position of the pointer with no input voltage is against the left-hand stop and off scale. The meter should indicate on scale only when a voltage within the range selected by the range switch is applied to the input terminals of the instrument (except when the "Null Det." switch is operated).

CALIBRATION ADJUSTMENT — Normally, no attention need be given to the matter of calibration as the large amount of feedback in the instrument gives it sufficient inherent stability to maintain the original factory calibration within the accuracy specified. However, to correct errors which might result from the cumulative effects of wide variations in characteristics of replacement tubes from average tubes, a variable control has been provided which allows the calibration to be shifted a small amount. Access to this control is possible with a screw-driver after removing the plug button situated on the side of the voltmeter close to the amplifier output connector.

In adjusting the calibration of the instrument the source voltage should be a *pure* sinusoidal wave of any convenient frequency from 100 to 10,000 c.p.s. and the rms indicating voltmeter used as the standard should be accurate to at least 1% at the selected test frequency.

USE AS A NULL DETECTOR — Although the Model 310A voltmeter possesses adequate sensitivity to detect unbalance voltages for most bridge measurement work, a condition may arise where the unbalance voltage will be less than 100 microvolts in which case the pointer of the voltmeter will fall below the left-hand extremity of the scale when working on the 0.001 volt range. In this contingency the null balance may be consummated by depressing the null detector switch marked "Null Det." thereby supplying a small bias current to the indicating meter and bringing the pointer to an on-scale reading even in the absence of an input signal. With this switch depressed the direct-reading feature of the voltmeter is temporarily invalidated and the instrument serves only to indicate the relative magnitudes of very low potentials in the order of 10 to 100 microvolts and in a frequency range of 10 cycles to 4 megacycles (except as discussed under "Measurements Below 100 Microvolts").

USE AS AN AMPLIFIER — Inserting a standard tip and sleeve telephone plug into the output jack marked "AC OUTPUT" automatically disconnects the indicating meter and makes the amplifier section of the voltmeter usable as a stable high gain preamplifier. When the range switch is set for the 0.001 range the gain of the amplifier is 60 DB which gain may be reduced to either 40 or 20 DB by setting the range switch to the 0.01 or the 0.1 setting respectively. The maximum undistorted output of the amplifier is 1 volt and its output impedance is 500 ohms. When fed into a load having a resistance of not less than 50,000 ohms and a capacitance of 40 to 70 pF (which may be that of the output cable) the amplifier will give a response uniform within ½ DB over the entire frequency range from 10 cycles to 2 megacycles.

The hum and noise level present at the output jack when the instrument is used as an amplifier is less than 20 millivolts on the most sensitive range (0.001 volt) and less than 2 millivolts on the other ranges. These noise levels are 34 DB and 54 DB respectively down from the maximum undistorted output voltage level of 1 volt. They are equivalent to less than 20 microvolts in series with the grid of the input tube.

POWER LEVEL MEASUREMENTS — In view of the many different applications for Ballantine Voltmeters and the prevailing differences in power reference levels, it was felt inadvisable to relate the db scale of the basic instrument to any particular level.* Accordingly, in the interest of clarity and generality, the 0 of the db scale has been set arbitrarily at 1 on the voltage scale, and 20 db, therefore, corresponds to 10 on the voltage scale.

The most frequently used power references at which a level of zero decibels is arbitrarily set are:

(1) 1 mW/600 Ω — 1 milliwatt of power corresponding to 0.775 volts across a pure resistance of 600 ohms.

(2) 6 mW/600 Ω — 6 milliwatts of power corresponding to 1.897 volts across a pure resistance of 600 ohms.

(3) 6 mW/500 Ω — 6 milliwatts of power corresponding to 1.732 volts across a pure resistance of 500 ohms.

The following table enables a ready conversion from the db reading of the Ballantine Scale to the actual zero db power level for any of the reference levels above including zero db corresponding to 1 volt.

If power reference levels other than those above are involved the Ballantine Laboratories, Inc., DB Slide Rule will be found very useful in the corresponding decibel level determinations. The slide rules are available free of charge on application to the Company.

MEASUREMENT OF CURRENT — By using Ballantine Series 600 Precision Shunt Resistors in conjunction with this voltmeter currents from 0.1 microampere to 3 amperes may be measured over a frequency range of 10 cps to 200 kilocycles with an accuracy approaching that of the voltmeter. If reduced accuracy is tolerable current measurements may be also made at frequencies up to 1 megacycle within the limits stated in our catalogue description of these Precision Shunt Resistors. The lowest Shunt available for minimizing voltage drops is 0.01 ohm, which may be used to measure currents from 10 milliamperes to 10 amperes up to 20,000 cps with an introduced error of less than 0.5%.

SERVICING — Servicing of this instrument by the user is not recommended except for the renewal of the fuse, illuminating lamps and tubes.

CAUTION

Do not remove either the V5-5654 Tube or the diode assembly 310A-X2 without first either switching the instrument off or inserting a telephone plug in the amplifier output jack. Damage to the diode assembly can result if this precaution is not observed.

WARNING

However, if attempts are made to investigate the internal parts of the voltmeter potentials as high as 400 VOLTS MAY BE ENCOUNTERED with respect to the chassis. When removing the panel from the outer case of the voltmeter unscrew only the four bright oval head screws at the edges of the panel, and not the black Phillips head screws.

REPLACEMENT OF TUBES — Maintenance of accuracy within the specified limits is dependent

*To serve those who frequently work with reference to zero dbm in 600 ohm circuits a special version Model 310A-S/1 is available with the db scale related directly to this datum.

MODEL 310A RANGE SETTING	DB TO BE ADDED TO OR SUBTRACTED FROM THE DB READING ON THE BALLANTINE DB SCALE IN ORDER TO CONVERT TO THE DESIRED ZERO REFERENCE LEVEL			
Volts Full Scale	Zero Level = 1mW-600 ohm	Zero Level = 6mW-600 ohm	Zero Level = 6mW-500 ohm	Zero Level = 1 volt
0.001	−77.8	−85.6	−84.8	−80
0.01	−57.8	−65.6	−64.8	−60
0.1	−37.8	−45.6	−44.8	−40
1.0	−17.8	−25.6	−24.8	−20
10.0	+ 2.2	− 5.6	− 4.8	0
100.0	+22.2	+14.4	+15.2	+20

on the extent of tube deterioration after the voltmeter has been subjected to extensive use. Even the stabilizing effect of negative feed-back cannot completely offset severe degradation of tube characteristics, especially when a number of tubes are involved simultaneously.

A simple test can be undertaken as follows to check the overall state of the amplifier tubes and so allow the user to decide whether tube replacement is necessary.

Insert an adjustable auto-transformer (such as a Variac) between the voltmeter and the power line. Feed a stable signal of audio frequency to the voltmeter input terminals and effect adjustments to produce an on-scale deflection. Note the change in reading as the line voltage is varied between the limits 105 and 125 volts. If the change exceeds 3% it is recommended that all amplifier tubes be checked for sub-normal transconductance.

This instrument is fitted with a lamp (Type TS47) mounted between the two 0A2 regulator tubes. The illumination from this lamp aids in the firing of these tubes under conditions of low line voltage. If the instrument exhibits excessive meter flutter after being turned on for a minute or so, check for a lamp failure. Occasionally an 0A2 tube, with aging, will become sluggish in firing even with the higher light ambient provided by the lamp, and the tube should therefore be replaced.

The failure of the meter illuminating lamps to light after the switch is turned on is an indication of either burned out lamps or a blown fuse. Access to these lamps for replacement purposes may be obtained by removing the cover of the indicating meter by unscrewing the two holding screws on the top. The fuse is located on the side of the voltmeter case through which the power cord passes. It is of the cartridge type and may be replaced without removing the voltmeter from its case by merely unscrewing the thumb screw marked "Fuse." Spare fuses are supplied but if additional fuses are required they are type 3AG, ¾ ampere, and may be ordered from any standard source of fuse supply.

Specialized techniques and highly precise calibration equipment are needed for thorough servicing of the voltmeter. It is therefore stressed that any major problem concerning its operation be reported to Ballantine Laboratories, Inc. whose engineering and repair departments will give it their prompt attention and will submit suggestions to deal with the difficulty. Give full details concerning conditions of usage, including the serial number of the voltmeter.

If, after acting on recommendations given by us, the difficulty still persists, or if the defect is clearly in the voltmeter and is not eliminated by tube replacement, the voltmeter should be returned via Railway Express packed in a surrounding of at least 3 or 4 inches of excelsior or similar material.

In the case of an instrument whose period of purchase exceeds the warranty period, a reasonable charge will be made for repairs and for replacement of faulty components including defective tubes.

WARRANTY — We warrant each instrument sold by us to be free from defects in material and workmanship. Our obligation under this warranty is limited to repairing or replacing any instrument or part thereof, except tubes or batteries, which shall, within 1 year after shipment to the original purchaser, prove upon our examination to be defective.

REPLACEMENT PARTS LIST

REFER TO MODEL 310A SCHEMATIC DIAGRAM MC-792E

B.L. PART NO.	CIRCUIT SYMBOL	CAPACITORS	MANUFACTURER
2140	C1	.047 μF, 600 v, Type 620S,	Goodall
2453	C2	0.5-5 pF, Variable Trimmer, Type 532,	Erie
2225	C3	8 pF, Type CM15C-080-J	El-Menco
2431	C4	3-12 pF, Type TS2A-3,	Erie
2404	C5	760 pF, Max., Type X305,	El-Menco
2407	C6	1600 pF, Max., Type X309,	El-Menco
2213	C7	.004 μF, Mica, Type 1W,	Cornell-Dubilier
2201	*C8	2 pF, Mica, Type CM-15-C-020-M,	Arco
2005	C9A	15 μF, 150 v, Type DFP,	Magnavox
	C9B	15 μF, 150 v, Type DFP,	Magnavox
	C9C	1000 μF, 2 v, Type DFP,	Magnavox
2040	C10	100 μF, 150 v, Type DFP,	Magnavox
2351	C11	1 μF, 200 v, Type 621M,	Goodall
2142	C12	0.1 μF, 200 v, Type 109P10492,	Sprague
2228	C13	50 pF, Type CM15E-500J,	El-Menco
2226	C14	3 pF, Type CM15-C-030M,	El-Menco
2451	C15	1-8 pF, Ceramic Variable, Type 532,	Erie
2101	C16	0.002 μF, 600 v, Type 68P22081H,	Magnavox
2005	C17A	15 μF, 150 v, Type DFP,	Magnavox
	C17B	15 μF, 150 v, Type DFP,	Magnavox
	C17C	1000 μF, 2 v, Type DFP,	Magnavox
2139	C18	.033 μF, 200 volt, Type 621S,	Goodall
2138	C19	0.1 μF, 200 volt, Type 620S,	Goodall
2503	C20	2.2 pF, Type GA,	Stackpole
2055	C21	25 μF, 25 v, Type DPE,	Sprague
2318	C22	2 μF, 200 v, PUP, −0 +10%,	Cornell-Dubilier
2055	C23	25 μF, 25 v, Type DPE,	Sprague
2055	C24	25 μF, 25 v, Type DPE,	Sprague
2018	C25	1000 μF, 10 v, Type DFP,	Magnavox
2030	C26A	10 μF, 450 v, Type DFP,	Magnavox
	C26B	30 μF, 450 v, Type DFP,	Magnavox
2029	C27	50 μF, 350 v, Type DFP,	Magnavox
2040	C28	100 μF, 150 v, Type DFP,	Magnavox
2040	C29	100 μF, 150 v, Type DFP,	Magnavox
2040	C30	100 μF, 150 v, Type DFP,	Magnavox
2232	*C31	150 pF, Type CM15-E-151-J,	El-Menco
2235	C32	33 pF, Type CM-15-E-390-J,	El-Menco
2226	*C34	3 pF, Type CM-15-C-030-M,	Arco

* The values of these items are determined during the calibration of the instrument and may differ from the values listed.

REPLACEMENT PARTS LIST

REFER TO MODEL 310A SCHEMATIC DIAGRAM MC-792E

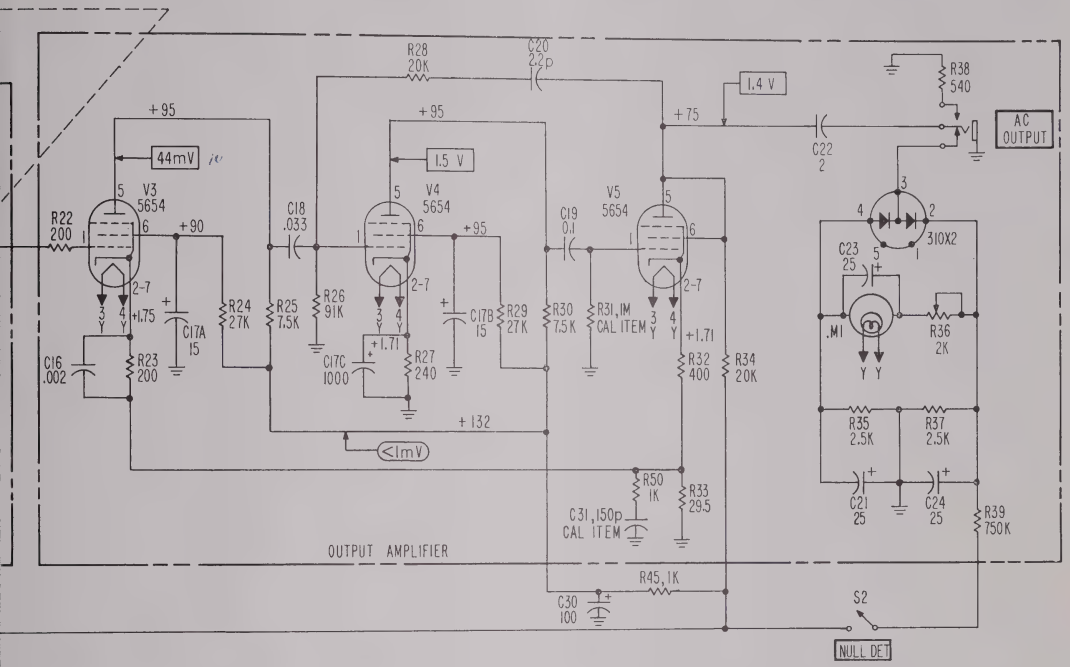
B.L. PART NO.	CIRCUIT SYMBOL	RESISTORS	MANUFACTURER
1060	R1	620 ohms, Type EB, 5%,	Allen-Bradley
1303	R2	250,000 ohms, Type CP-½, 1%,	Wilkor
1319	R3	20,400 ohms, Type CP-½, 1%,	Wilkor
1072	R4	39 ohms, Type EB, 5%,	Allen-Bradley
1335	R5	2,000 ohms, Type CP-½, 1%,	Wilkor
1260	R6	7.5 ohms, Type GB, 5%,	Allen-Bradley
1351	R7	200 ohms, Type CP-½, 1%,	Wilkor
1460	R8	2,000,000 ohms, Type CP-½, 1%,	Wilkor
1460	R9	2,000,000 ohms, Type CP-1, 1%,	Wilkor
1065	R10	200 ohms, Type EB, 5%,	Allen-Bradley
1353	R11	140 ohms, Type CP-½, 1%,	Wilkor
1041	R12	18,000 ohms, Type EB, 5%,	Allen-Bradley
1656	R13	7,500 ohms, Type N20, 1%,	Corning
1023	R14	200,000 ohms, Type EB, 5%,	Allen-Bradley
1064	R15	220 ohms, Type EB, 5%,	Allen-Bradley
1044	R16	10,000 ohms, Type EB, 5%,	Allen-Bradley
1366	R17	9,000 ohms, Type CP-½, 1%,	Wilkor
1338	R18	1,000 ohms, Type CP-½, 1%,	Wilkor
1461	R19	1,000,000 ohms, Type CP-½, 1%,	Wilkor
1308	R20	111,100 ohms, Type CP-½, 1%,	Wilkor
1060	*R21	620 ohms, Type EB, 5%,	Allen-Bradley
1065	R22	200 ohms, Type EB, 5%,	Allen-Bradley
1065	R23	200 ohms, Type EB, 5%,	Allen-Bradley
1081	R24	27,000 ohms, Type EB, 5%,	Allen-Bradley
1325	R25	7,500 ohms, Type CP-½, 1%,	Wilkor
1091	R26	91,000 ohms, Type EB, 5%,	Allen-Bradley
1082	R27	240 ohms, Type EB, 5%,	Allen-Bradley
1040	R28	20,000 ohms, Type EB, 5%,	Allen-Bradley
1081	R29	27,000 ohms, Type EB, 5%,	Allen-Bradley
1325	R30	7,500 ohms, Type CP-½, 1%,	Wilkor
1010	R31	1,000,000 ohms, Type EB, 5%,	Allen-Bradley
1345	R32	400 ohms, Type CP-½, 1%,	Wilkor
1754	R33	29.5 ohms, Special, 1%,	Ballantine
1040	R34	20,000 ohms, Type EB, 5%,	Allen-Bradley
1712	R35	2,500 ohms, Type RS-2, 1%,	Dale
1814	R36	2,000 ohms, Type W-2000 Pot,	I.R.C.
1712	R37	2,500 ohms, Type RS-2, 1%,	Dale
1342	R38	540 ohms, Type CP-½, 2%,	Wilkor
1012	R39	750,000 ohms, Type EB, 5%,	Allen-Bradley
1716	R40	800 ohms, Type 5KT, 5%,	Sprague
1717	R41	3,750 ohms, Type 5KT, 5%,	Sprague
1268	R42	1,300 ohms, Type GB, 5%,	Allen-Bradley
1706	R44	3,500 ohms, Type 5KT, 5%,	Sprague
1057	R45	1,000 ohms, Type EB, 5%,	Allen-Bradley
1062	R47	300 ohms, Type EB, 5%,	Allen-Bradley
1083	R49	82 ohms, Type EB, 10%,	Allen-Bradley
1057	*R50	1,000 ohms, Type EB, 5%,	Allen-Bradley
1026	R52	100,000 ohms, Type EB, 5%,	Allen-Bradley

* The values of these items are determined during the calibration of the instrument and may differ from the values listed.

REPLACEMENT PARTS LIST

REFER TO MODEL 310A SCHEMATIC DIAGRAM MC-792E

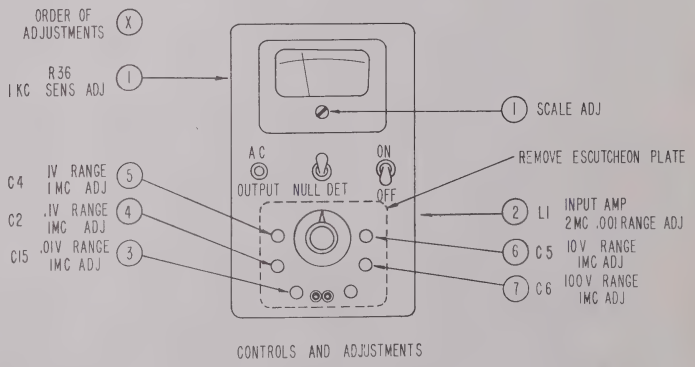
B.L. PART NO.	CIRCUIT SYMBOL	OTHER COMPONENTS	MANUFACTURER
3006	L1	Peaking Coil,	Ballantine
3030	T1	Power Transformer, Code 79-51R,	Ballantine
3406	F1	¾ amp. fuse, Type 3AG,	Littelfuse
3451	I1	Pilot Light, Type 47,	General Electric
3162	M1	Indicating Meter,	Ballantine
3230	S1	Range Switch,	Ballantine
3268	S2	ON-OFF Switch,	Ballantine
3269	S3	NULL DET. Switch,	Ballantine
3126	V1, 2, 3, 4, 5	Type 5654 Tube,	General Electric
3105	V6	Type 6X4 Tube,	R.C.A.
3106	V7, 8	Type 0A2 Tube,	R.C.A.
3144	CR1	Crystal Diode, Type S53,	Transitron
3075	CR2	Selenium Rectifier, Type P1B1S1A,	Radio Receptor



SERVICE TESTS

	OUTPUT	LIMITS	REMARKS
TED	AC OUTPUT	20mV MAX	CHECKS TUBES V1, V2, V3
ED	TUBE PINS	AS ON SCHEMATIC ± 10%	CHECKS CIRCUIT
GE T	AC OUTPUT	1V ± 5%	CHECKS CIRCUIT
GE T	METER	2% MAX. CHANGE OF IND. FOR 105-125V LINE	CHECKS STABILITY
GE T	PIN 5 OF V2	70 TO 90mV	CHECKS INPUT AMPLIFIER
GE JT	OUTPUT JACK	3.5 TO 4.5 V	CHECKS OUTPUT AMPLIFIER

C)
TAGE (120 CPS)



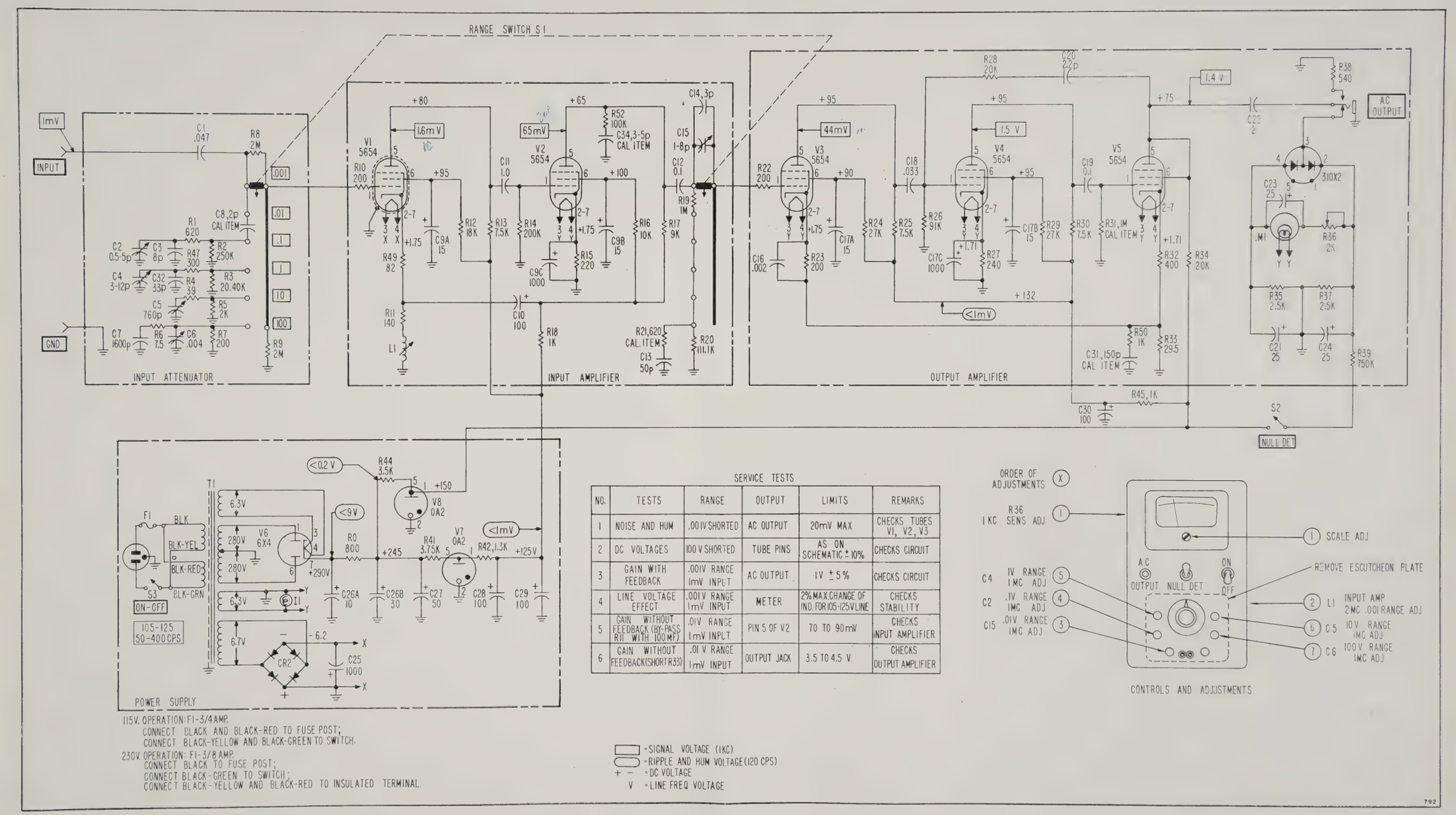
CONTROLS AND ADJUSTMENTS

792

REPLACEMENT PARTS LIST

REFER TO MODEL 310A SCHEMATIC DIAGRAM MC-792E

B.L. PART NO.	CIRCUIT SYMBOL	OTHER COMPONENTS	MANUFACTURER
3006	L1	Peaking Coil,	Ballantine
3030	T1	Power Transformer, Code 79-51R,	Ballantine
3406	F1	¾ amp. fuse, Type 3AG,	Littelfuse
3451	I1	Pilot Light, Type 47,	General Electric
3162	M1	Indicating Meter,	Ballantine
3230	S1	Range Switch,	Ballantine
3268	S2	ON-OFF Switch,	Ballantine
3269	S3	NULL DET. Switch,	Ballantine
3126	V1, 2, 3, 4, 5	Type 5654 Tube,	General Electric
3105	V6	Type 6X4 Tube,	R.C.A.
3106	V7, 8	Type 0A2 Tube,	R.C.A.
3144	CR1	Crystal Diode, Type S53,	Transitron
3075	CR2	Selenium Rectifier, Type P1B1S1A,	Radio Receptor



CONTROLS AND ADJUSTMENTS

SERVICE TESTS

NO.	TESTS	RANGE	OUTPUT	LIMITS	REMARKS
1	NOISE AND HUM	.001V SHORTED	AC OUTPUT	20mV MAX	CHECKS TUBES V1, V2, V3
2	DC VOLTAGES	100 V SHORTED	TUBE PINS	AS ON SCHEMATIC ± 10%	CHECKS CIRCUIT
3	GAIN WITH FEEDBACK	.001V RANGE 1mV INPUT	AC OUTPUT	1V ± 5%	CHECKS CIRCUIT
4	LINE VOLTAGE EFFECT	.001V RANGE 1mV INPUT	METER	2% MAX. CHANGE OF IND. FOR 105-125 V LINE	CHECKS STABILITY
5	GAIN WITHOUT FEEDBACK (BY-PASS R11 WITH 100 MF)	.01V RANGE 1mV INPUT	PIN 5 OF V2	70 TO 90 mV	CHECKS INPUT AMPLIFIER
6	GAIN WITHOUT FEEDBACK (SHORT R33)	.01 V RANGE 1mV INPUT	OUTPUT JACK	3.5 TO 4.5 V	CHECKS OUTPUT AMPLIFIER

115V. OPERATION: F1-3/4 AMP.
CONNECT BLACK AND BLACK-RED TO FUSE POST;
CONNECT BLACK-YELLOW AND BLACK-GREEN TO SWITCH.

230V. OPERATION: F1-3/8 AMP.
CONNECT BLACK TO FUSE POST;
CONNECT BLACK-GREEN TO SWITCH;
CONNECT BLACK-YELLOW AND BLACK-RED TO INSULATED TERMINAL.

▭ = SIGNAL VOLTAGE (1KC)
⬭ = RIPPLE AND HUM VOLTAGE (120 CPS)
+ − = DC VOLTAGE
V = LINE FREQ VOLTAGE

CAPACITORS: NOT MARKED — MICROFARADS (10^{-6}F)
p — PICOFARADS (10^{-12}F)
RESISTORS: NOT MARKED — OHMS (Ω)
K — KILOHMS (10^{3}Ω)
M — MEGOHMS (10^{6}Ω)
VOLTAGES: NOT MARKED — VOLTS (V)
mV — MILLIVOLTS (10^{-3}V)

792

Sensitive Electronic Voltmeter Model 310A Issue MC-792E

BALLANTINE LABORATORIES, INC.
BOONTON, N. J.

ENGINEERING SERVICES REQUEST

No. SLR-0008
(E. S. DEPT. USE ONLY)

○ EMERGENCY or Date Required 9-10-63

ature of Request:

Repair L26FP-3 Ballantine voltmeter range switch defective (10V & 100V)

om: Name K Schwengert Plant W Dept. R&D Lab Ext. 229

ate 9-3-63 Phone Request Rec'd by Time

Eqpt. Tag No. (if any) L26-FP-3
Description BALLANTINE VTVM

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

ssigned to: Section Standards Lab Approved RH (SUPV.)

Authorized (ESD MGR.)

ction Taken:

Trouble intermittent. Low Frequency response drops off within 1 hour after it is turned on. Trouble goes away when any attempt was made to service it and it would work properly for the remainder of the day. Sent to Ballantine Lab. with a letter explaining trouble.

Rec'd from Ballantine, 11-18-63, Calibration found OK. Warranty — (No charge)

ite Completed 11-19-63 by Eugene E. Kurtz

tal Hours 5

Approved RH (SUPV.)

tal Mtl.

Approved (ESD MGR.)

○ ES DEPT FILE COPY
GREEN
(ORIGINAL)

○ SECT. SUPV. COPY
PINK
(1st CARBON COPY)

○ ORIGINATORS COPY
CANARY
(2nd CARBON COPY)

GET COPY

PURCHASE ORDER

HAMMOND ORGAN
"music's most glorious voice"

HAMMOND ORGAN COMPANY

2915 N. WESTERN AVENUE - CHICAGO 18, ILLINOIS - BRunswick 8-4100

DATE OCTOBER 4, 1963

PURCHASE ORDER No. 87547

BALLANTINE LABORATORIES, INC.
C/O MR. F. ZAYAC
BOONTON, NEW JERSEY

THIS ORDER TO CONSIST OF 1 PAGE UNLESS MARKED; PAGE _____ OF _____

1. 2915 N. WESTERN AVE., CHICAGO 18, ILL.
2. 5008 W. BLOOMINGDALE AVE., CHICAGO 39, ILL.
3. 4200 W. DIVERSEY AVE., CHICAGO 39, ILL.
4. 1740 N. 25th AVE. MELROSE PK., ILL.
5. EVERETT ORGAN COMPANY 4045 N. ROCKWELL AVE. CHICAGO 18, ILL.

Please furnish the following material subject to the conditions of purchase noted below.

VIA: AIR EXPRESS

TITY	DESCRIPTION OF ARTICLES	PRICE NOT TO EXCEED
	MATERIALS MUST ARRIVE IN OUR PLANT ON DATE (OR WEEK) SHOWN IN RED	
	OCTOBER 25, 1963	
11/14/63 LY	REPAIR MODEL 310A, SERIAL NO. 7383, HAMMOND NO. L26-FP-3 REQ.21968	No Charge ADVISE

No Charge

NOTE: PLEASE REFER TO OUR LETTER DATED OCTOBER 2, 1963,, SIGNED BY MR. R. HOLPUCH.

ABOVE BEING SENT TO YOU ON OUR SHIPPER P-26193.

For further information concerning this order please communicate with Mr. ZEDLER

☐ FOR RESALE
☒ NOT FOR RESALE

1. DESTINATION
2. SHIPPING POINT-PREPAY & BILL
3. SHIPPING POINT-COLLECT
4. SHIPPING POINT FREIGHT ALLOWED OR ADJUSTED
5.

ACCOUNT NO. (FOR OUR USE ONLY) ENG. 80790

DELIVER TO (FOR OUR USE ONLY) HOLPUCH TERMS NET

TY	DATE REC'D.	BALANCE DUE	QUANTITY	DATE REC'D.	BALANCE DUE	QUANTITY	DATE REC'D.	BALANCE DUE

ARTMENT HEAD
SION HEAD
ERAL MANAGER
TROLLER
CHASING AGENT

PLEASE CHECK AND FORWARD TO NEXT ON LIST

HAMMOND ORGAN CO.

PURCHASE REQUISITION

Date

Ballantine Laboratories, Inc.
Boonton, New Jersey

P. O. No. 10/2/63

Dated 9-25-47

Vanted

Via

☒ Western ☐ Bloomingdale ☐ Diversey ☐ Rockwell ☐ Melrose Park

ITY	DESCRIPTION	This Space For Purchasing Dept. Only
	Repair Ballantine Model 310A, Serial No. 7383, Hammond No. L26-FP-3	
	To be shipped to Mfr. for Repair - Attn: Mr. Frank Mayac	
	(Letter written to Ballantine 10/2/63)	
	Pick-Up in Engrg. Services Dept. (Standards Lab.)	
	Local Repr. - Lang, Claeson & Assoc.	

TERMS:

equisitions covering major machinery and equipment, please fill in:

ION: PLANT Western, FLOOR 2nd; DEPARTMENT Engrg. Services

:o
n of R. Holpuch Charge 80790

Approved Authorized

15M 14-60-259

HAUTAU & OTTO CHICAGO 44, ILLINOIS

ENGINEERING SERVICES REQUEST

No. SLR-0129
(E. S. DEPT. USE ONLY)

○ EMERGENCY Date Required ASAP

ature of Request:

Meter INACCURATE 4%

om: Name Wm. L. Lambert Jr. Plant Dept. Develop Ext.

ate 11-25-64 Phone Request Rec'd by Time

Eqpt. Tag No. (if any) 226-FP-1
Description ELECTRONIC Voltmeter
BALLANTINE 310A

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

signed to: Section Standards Lab Est. Completion Date

pproved (SUPV.) Authorized (ESD MGR.)

tion Taken:

6X4 REQUIRED REPLACEMENT
DEVELOPED 2+ WAS LOW, PRIOR TO
REPLACEMENT OF RECTIFIER.
ALL READINGS WERE LOW BY 4%

te Completed 11-25-64 by G. Kuehl

tal Hours 3

tal Mtl. $1.00

Approved (SUPV.)

Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

ENGINEERING SERVICES REQUEST

No. SLR-0134
(E. S. DEPT. USE ONLY)

○ EMERGENCY Date Required ASAP

ature of Request:

METER READS LOW

rom: Name WILLIAM C. RING Plant WESTERN Dept. _____ Ext. _____

ate 1-4-65. Phone Request Rec'd by _____ Time 11 30

Eqpt. Tag No. (if any) L26-FP-3
Description BALLANTINE MODEL 310A V.T.V.M.

Est. Hours _____ Mtl. _____
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

ssigned to: Section STANDARDS LAB Est. Completion Date _____

pproved RH (SUPV.) Authorized _____ (ESD MGR.)

ction Taken:

ERRATIC READINGS CAUSED BY RANGE SWITCH CONTACTS WHICH REQUIRED CLEANING. TESTED CALIBRATION IS FOUND WITHIN SPECIFICATIONS.

ate Completed 1-6-65 by Gerald Kessel

otal Hours 3

otal Mtl. _____

Approved RH (SUPV.)

Approved _____ (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

1-036

ENGINEERING SERVICES REQUEST

No. SLR-0154
(E. S. DEPT. USE ONLY)

EMERGENCY Date Required

ature of Request:

LOW READING ON ALL RANGES. With no input

om: Name Myra Lee Plant West Dept. RED Ext. 278

ate 2-24-1965 Phone Request Rec'd by Time

Eqpt. Tag No. (if any) L-26-FP-4
Description Ballantine 310A V.T.V.M.

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

ssigned to: Section Standards Lab Est. Completion Date

pproved (SUPV.) Authorized (ESD MGR.)

ction Taken:

Replaced input Filter capacitor but condition still manifested itself. Found 2nd ohm resistor in Grid circuit of V3 was not contacting Pin (1) Gr. The grid was floating with no input conviction Signal on meter was just steady picking from air

ate Completed 3-4-65 by Gerald Kent

otal Hours 4

otal Mtl. #2.00

Approved (SUPV.)

Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

1-036

ENGINEERING SERVICES REQUEST

No. SLR-0170
(E. S. DEPT. USE ONLY)

○ EMERGENCY Date Required ASAP

Nature of Request:

FOUR SCALE LAMPS & TST CAL (Location)

From: Name NORMAN KOULS Plant WESTERN Dept. CALIBRATION Ext.

Date 5-4-65 Phone Request Rec'd by VISUAL INSPECTION Time

Eqpt. Tag No. (if any) L2L-EP-2

Description Eaton VIVM Model 310A

Est. Hours Mtl.

Work Order No. E-5094

Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

Assigned to: Section Standards Lab Est. Completion Date

Approved MH (SUPV.) Authorized (ESD MGR.)

Action Taken:

REPLACED LAMPS & TESTED CALIBRATION & FOUND WITHIN SPECIFICATIONS

Date Completed 5-4-65 by Gerald Kuul

Total Hours 1

Total Mtl. .50

Approved MH (SUPV.)

Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

01-036

ENGINEERING SERVICES REQUEST

No. SLR-6180
(E. S. DEPT. USE ONLY)

○ EMERGENCY Date Required ASAP

Nature of Request:

REPAIR BALLANTINE A.C. VTVM.
(LEADS LOW 15%)

From: Name W. C. Ring Plant West Dept. RED Ext.

Date 6/30/65 Phone Request Rec'd by Time

Eqpt. Tag No. (if any) L26-EP-3
Description Ballantine 310A

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

Assigned to: Section STANDARDS LAB Est. Completion Date

Approved RH. (SUPV.) Authorized (ESD MGR.)

Action Taken:

CAL REGULATOR WAS NOT
FIRING. NOTED NO. 47 LAMP WAS OPEN.
THIS LAMP AIDS IN IONIZING REGULATOR
TUBES. REPLACED LAMP & REGULATOR TUBE
CAL. BEATER METER FOUND METER
OPERATING SATISFACTORILY.

Date Completed 6-30-65 by Gerald Kunel

Total Hours 2

Total Mtl. $3.50

Approved RH (SUPV.)

Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

11-036

ENGINEERING SERVICES REQUEST

No. SLR-0800
(E. S. DEPT. USE ONLY)

Date Required ASAP

Nature of Request:

Meter not meeting specifications for accuracy. OK

From: Name R. Cornmesser Plant West Dept. Ext.

Date 9-20-65 Request Approved By

Eqpt. Tag No. (if any) L26-FP-3
Description Ballantine 310A

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. EE-29

FOR E.S. DEPT. USE ONLY

Assigned to: Section Standards Lab Est. Completion Date

Approved (SUPV.) Authorized (ESD MGR.)

Action Taken:

Inaccurate readings were caused by calibrate point shifting due to defective Cal pot R36. Monitored meter for several days spot checks showed good stability.

Date Completed 9-28-65 by Harold Kenel

Total Hours 4

Total Mtl.

Approved (SUPV.)

Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

01-036

ENGINEERING SERVICES REQUEST

No. SLR-0311
(E. S. DEPT. USE ONLY)

Date Required ASAP

Nature of Request:

Does not hold calibration

From: Name [signature] Plant Western Dept. R&D Ext. 278

Date 1-20-67 Request Approved By

Eqpt. Tag No. (if any) L26-FP-4
Description Hymn 310A Ballantine

Est. Hours Mtl.
Work Order No. E-5094
Assignment No. SL-129

FOR E.S. DEPT. USE ONLY

Assigned to: Section Ind Lab Est. Completion Date

Approved PHH (SUPV.) Authorized (ESD MGR.)

Action Taken:

Did find meter did not hold calibration. Checked meter per manual (applied 105 VAC to power line and apply signal to input terminals and monitor input with external meter). L26-FP-4 varied more than 3%. Changed V1 thru V5 (5654's) all were low in gm. Meter was stable with line change but still did not hold calibration. Took "cal pot" apart and cleaned. Let meter run, it was O.K. Repaired and calibrated.

Date Completed 3-23-67 by Ed Madyzyk

Total Hours 8 Approved PHH (SUPV.)

Total Mtl. $10.00 Approved [signature] (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

01-036

HAMMOND ORGAN COMPANY

ELECTRICAL EQUIPMENT LABORATORY

EQUIPMENT SERVICE AND OR CALIBRATION REPORT

( ) EMERGENCY (X) ROUTINE

DESCRIPTION OF EQUIPMENT A-4 V.T.L.M.

EL NO. L24 FF-3 M - NO. _____ LOCATION SEMICONDUCTOR SECTION

DATE 05-16-62 TIME NOTIFIED _____ REPORTED BY R. FELSON

NATURE OF COMPLAINT: STABILIZER CHECK SHOULD FREQ. RESPONSE 1½ % SPEC SPECIFICATIONS.

ANALYSIS: TROUBLE SHOT MACHINE RE-VTLM AND FOUND C-15 VARIABLE BAD CRACK.

REMEDY: REPLACE C-15 AND RECALIBRATED MACHINE

TIME REQUIRED TO SERVICE EQUIPMENT 6 HRS. COST OF MATERIALS $1.70

TOTAL TIME EQUIPMENT NOT IN USE _____ PREPARED BY R. Felson

QL-005

HAMMOND ORGAN COMPANY

ELECTRICAL EQUIPMENT LAB.

ELECTRICAL EQUIPMENT HISTORY FILE

NO. 126-VT-8 E. NO. _____ FILE _____

TITLE Meter; A.C. Vacuum Tube Volt

TYPE NO. _____ MODEL NO. 310A SERIAL NO. 8426

DESCRIPTION Voltage range: 100μ volts to 100 volts in 6 decade ranges. Frequency range: 10 cps. to 2MC. Accuracy: 3% from 10 cps. to 1 MC. 5% above 1 megacycle. Input impedance: 2 megohms.

MANUFACTURER Ballantine Lab., Inc., Boonton, N.J.

SUPPLIER Manufacturer

COST $255.00 DATE ORDERED _____ DATE RECEIVED 7-25-61 DATE CONSTRUCTION COMPLETED _____

LOCATION: PLANT: Western FLOOR 2nd DEPT. Design (Comp. Eval. Sect.)

PART OF ASSEMBLY NOS. TESTED OR PROCESSED _____

DESCRIPTION _____

PRODUCT USED IN: MODEL NO. _____ NAME _____

ES NOS. PERTAINING TO PART OF ASSEMBLY _____

DESCRIPTION OF TESTS PERFORMED General purpose.

IN NOS. PERTAINING TO TEST. Instruction book supplied by manufacturer.

DRAWING SHEET NO.	SIZE	DATE	COMMENTS AND REVISIONS	DATE
			ANALYSIS SHEET NO. INSTR. L42-NR-1	

(01-001)

ENGINEERING SERVICES REQUEST

No. SLR-0474
(E. S. DEPT. USE ONLY)

Date Required ASAP

ature of Request:

METER DROPPED - FUSE POST BROKEN OFF.
REPAIR & CHECK CALIBRATION

om: Name W. RING Plant WEST Dept. S C Ext.

ate Request Approved By

Eqpt. Tag No. (if any) L26-FP-3
Description AC-VTVM

Est. Hours Mtl.
Work Order No. E-5044
Assignment No. SL-129

FOR E.S. DEPT. USE ONLY

signed to: Section S.L. Est. Completion Date

pproved (SUPV.) Authorized (ESD MGR.)

tion Taken:

replaced fuse holder and fuse inspected meter for other damage and found a Broken .047 ufd cap conn to the input Binding post replaced cap and calibrated meter. also replaced one pilot lamp.

te Completed 4-16-69 by

al Hours 2.50 hrs Approved (SUPV.)

al Mtl. 9.31 Approved (ESD MGR.)

GREEN – ES DEPT. FILE COPY PINK – SECT. SUPV. COPY CANARY – REPORT COPY WHITE – ORIGINATOR'S COPY

12-18-72

ENGINEERING SERVICES REQUEST

No. SLR-0831

Date Required ASAP

① Name RICHARD HOLPUCH Dept. ENGINEERING Sect. STANDARD LAB.

② Name J. C. LIND Dept. ENGINEERING Sect. CONSOLE

Plant WESTERN Phone EXT. 213 Approved By

TURE OF REQUEST:

METER INDICATES SOMETIMES AND NOT OTHER

pt. Tag No. (if any) 126-FP-3

escription AC. METER

Est. Hours Mtl.

Work Order E-5044

Assignment SL-139

③ ssigned To: Name C. Kennedy Dept. Sect.

By: Authorized

CTION TAKEN:

SAKS Lead Replaced, Calibrated

ate Completed 12-18-72 By C. Kennedy Engr. Hrs. 1.50 Mtl. 2.93

pproved M.S. Hrs. Other

ROUTING WHEN COMPLETE: Green – ① Pink – ③ Yellow – ② White – Originator Keeps

Est. Hours

Assignment

e 12/12/72

ENGINEERING SERVICES REQUEST

No. SLR-0828

Date Required 12/12/72

O: ① Name C. KENNEDY Dept. ENG Sect. STDS LAB

OM: ② Name D. LONG Dept. ENG Sect. STDS & COMP

Plant WESTERN Phone Approved By

ATURE OF REQUEST:

REPAIR & CALIBRATE BALLANTINE ACV/DB METER ON ANECHOLIC CHAMBER TEST SET-UP (STILL DOES NOT DEFLECT FULL SCALE)

pt. Tag No. (if any) L26-FP-8

escription V.T.V.M

Est. Hours Mtl.

Work Order E-5894

Assignment SL-139

ssigned To: ③ Name C. Kennedy Dept. Sect.

By: Authorized

CTION TAKEN:

6X4 Bad Replaced Calibrated

te Completed 12-18-72 By C. Kennedy Eng. Hrs. 1.50 Mtl. 1.50

pproved M.S. Hrs. Other

ROUTING WHEN COMPLETE: Green – ① Pink – ③ Yellow – ② White – Originator Keeps

ENGINEERING SERVICES REQUEST

No. SLR-0826

Date Required 12/7/72

①
Name C. KENNEDY Dept. ENG Sect. STDS LAB

②
Name D. LONG Dept. ENG Sect. COMPONENTS LAB

Plant WESTERN Phone Approved By

TURE OF REQUEST:

POINTER DOES NOT DEFLECT FULL SCALE

pt. Tag No. (if any) L 26-FP-8

scription BALLANTINE A.C. VOLTMETER

Est. Hours Mtl.

Work Order E-5094

Assignment SL-139

③
signed To: Name C. Kennedy Dept. T.E.E Sect. STDS LAB

By: Authorized

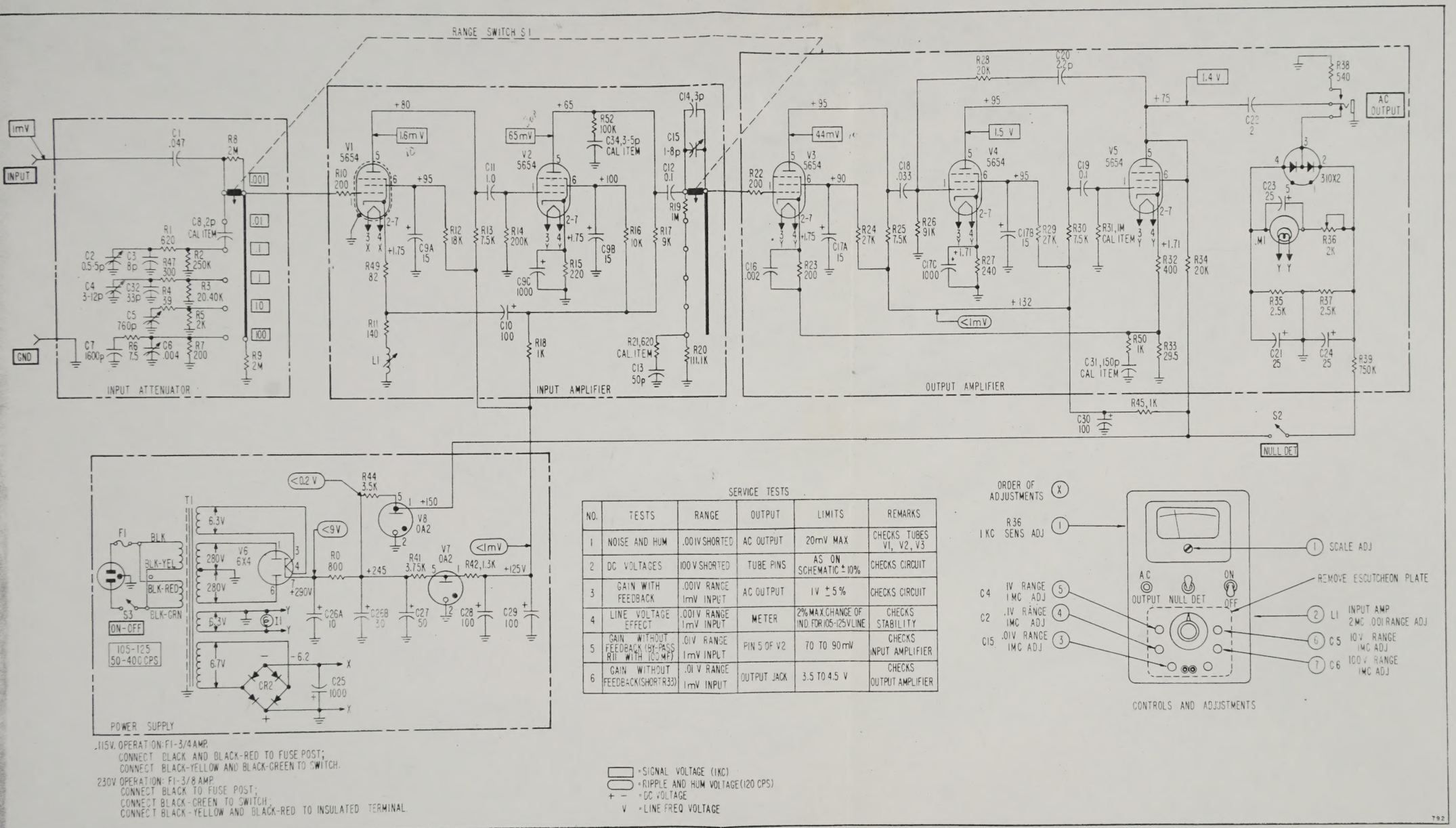
CTION TAKEN:

6 PKS Weak Replaced, Calibrated

te Completed 12/7/72 By C. Kennedy Eng. Hrs. 1.00 Mtl. 1.43

pproved M.S. Hrs. Other

ROUTING WHEN COMPLETE: Green – ① Pink – ③ Yellow – ② White – Originator Keeps



.115V. OPERATION: F1-3/4 AMP.
CONNECT BLACK AND BLACK-RED TO FUSE POST;
CONNECT BLACK-YELLOW AND BLACK-GREEN TO SWITCH.

230V OPERATION: F1-3/8 AMP.
CONNECT BLACK TO FUSE POST;
CONNECT BLACK-GREEN TO SWITCH;
CONNECT BLACK-YELLOW AND BLACK-RED TO INSULATED TERMINAL.

SERVICE TESTS

NO.	TESTS	RANGE	OUTPUT	LIMITS	REMARKS
1	NOISE AND HUM	.001V SHORTED	AC OUTPUT	20mV MAX	CHECKS TUBES V1, V2, V3
2	DC VOLTAGES	100V SHORTED	TUBE PINS	AS ON SCHEMATIC ± 10%	CHECKS CIRCUIT
3	GAIN WITH FEEDBACK	.001V RANGE 1mV INPUT	AC OUTPUT	1V ± 5%	CHECKS CIRCUIT
4	LINE VOLTAGE EFFECT	.001V RANGE 1mV INPUT	METER	2% MAX CHANGE OF IND. FOR 105-125V LINE	CHECKS STABILITY
5	GAIN WITHOUT FEEDBACK (BY-PASS R11 WITH 100 MF)	.01V RANGE 1mV INPUT	PIN 5 OF V2	70 TO 90 mV	CHECKS INPUT AMPLIFIER
6	GAIN WITHOUT FEEDBACK (SHORT R33)	.01V RANGE 1mV INPUT	OUTPUT JACK	3.5 TO 4.5 V	CHECKS OUTPUT AMPLIFIER

CONTROLS AND ADJUSTMENTS

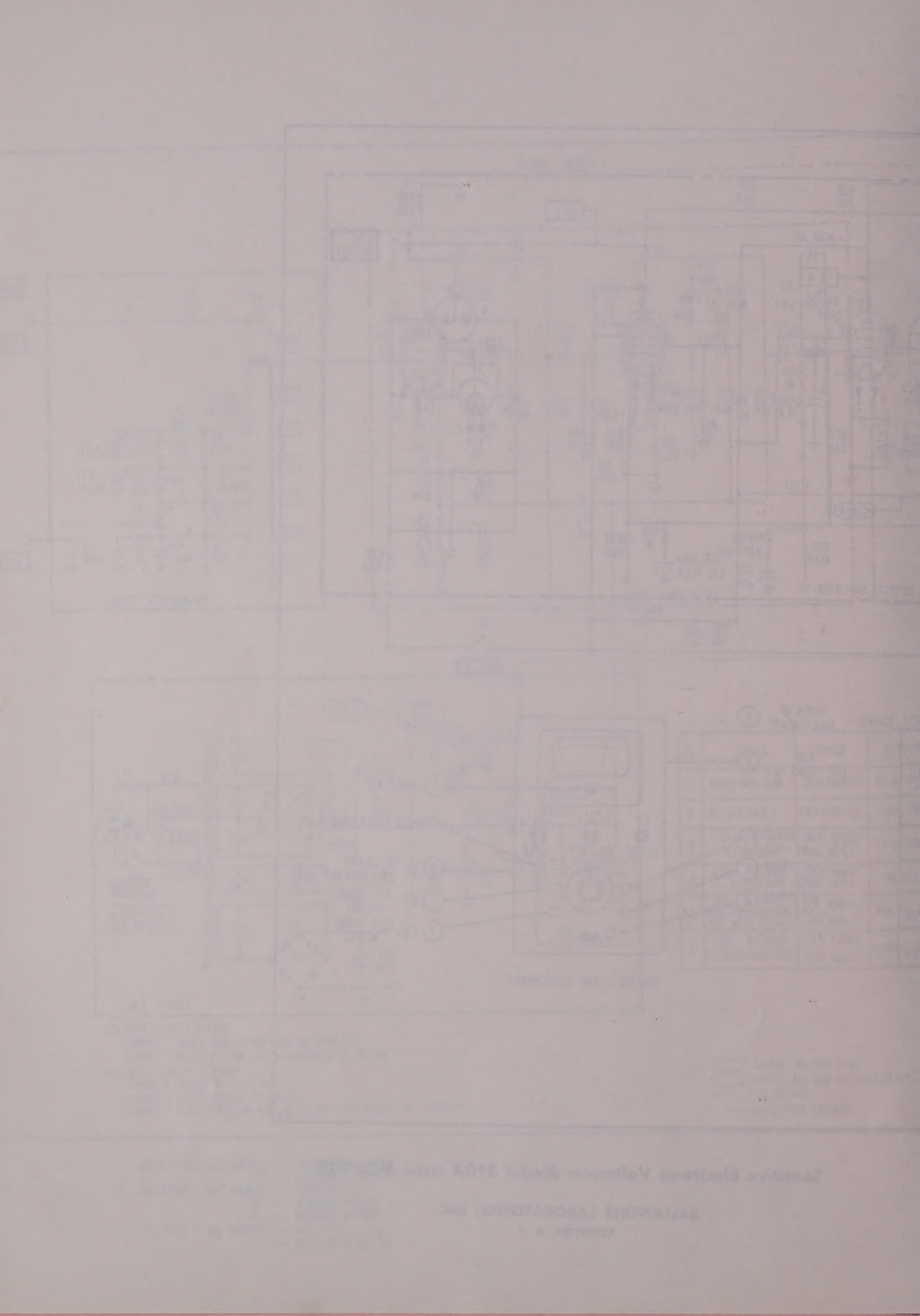
ORDER OF ADJUSTMENTS: X
1 — R36 1 KC SENS ADJ
2 — L1 INPUT AMP 2MC .001 RANGE ADJ
3 — C15 .01V RANGE IMC ADJ
4 — C2 .1V RANGE IMC ADJ
5 — C4 1V RANGE IMC ADJ
6 — C5 10V RANGE IMC ADJ
7 — C6 100V RANGE IMC ADJ
SCALE ADJ
REMOVE ESCUTCHEON PLATE
AC OUTPUT · NULL DET · ON · OFF

= SIGNAL VOLTAGE (1KC)
= RIPPLE AND HUM VOLTAGE (120 CPS)
+ − = DC VOLTAGE
V = LINE FREQ VOLTAGE

CAPACITORS: NOT MARKED — MICROFARADS (10^{-6}F)
p — PICOFARADS (10^{-12}F)
RESISTORS: NOT MARKED — OHMS (Ω)
K — KILOHMS (10^{3}Ω)
M — MEGOHMS (10^{6}Ω)
VOLTAGES: NOT MARKED — VOLTS (V)
m/ — MILLIVOLTS (10^{-3}V)

Sensitive Electronic Voltmeter Model 310A Issue MC-792E

BALLANTINE LABORATORIES, INC.
BOONTON, N. J.



525
Canfield
LIGHT RED